PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Nassau 924. Cable Address: "Electrical," New York.

New England Office, 146 Franklin Street, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

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Times Building, New York
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VOL. XV. NEW YORK, JUNE 14, 1890. No. 24.

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A Chance for Inventors. THE very encouraging reports of long life for incandescent lamps naturally lead one to inquire what can be done with the variety designed for use on arc circuits. A hundred candle-power series lamp of reasonable durability would change the present method of in-door lighting radically, and drive the arc light into the streets. A powerful glow lamp is nearly the equivalent of an arc in luminosity, and easily surpasses it in steadiness and convenience. Here is a grand chance for improvement, and a possibility of brilliant commercial success. Who will be first to obviate the present difficulties, and bring to the front a method of illumination that possesses so many advantages?

An Electric Traveling Crane. THE immense flexibility of electricity as a method of transmitting power has seldom been better shown than by the hoisting and conveying machine illustrated in this issue. A single man operating the apparatus can transfer very large amounts of freight with the greatest rapidity and facility. Heretofore the use of cranes and the like to load and unload cars and steamers has been no very simple affair, requiring a considerable amount of attendance and no small expenditure of time. When the present apparatus is once installed these difficulties are in great measure overcome. Its use is another proof of the important part that electricity is playing in the industrial operations of the present time.

Another Chance for Rapid Transit. THE cable bill has died of neglect and exposure, and the public will not hold any mass meeting to pass resolutions of condolence. A mass meeting is quite in order, however, to insist on immediate action looking toward a proper system of rapid transit for this unfortunate city. Now is the time for establishing an adequate underground or semi-underground system stretching the entire length of Manhattan Island. A four-track electric road, even if underground for its its entire length, would give a method of traveling that compared to the elevated roads would be ideal luxury. No reasonable being can enjoy the noisome smoke and dust of an underground steam road, and there could be no better chance than that before us for electricity to show its magnificent possibilities.

The Lightning-Rod Season. Now is the time for inhabitants of the rural districts to conjure up the annual thunderstorm scare and invoke the shade of Ben Franklin by converting houses and barns into the semblance of colossal metallic porcupines. Scoffing neighbors console them with jeers, but perhaps erect wooden rods to scare away that "hardy perennial" the lightning rod agent. Something is to be said on both sides of the question. It is quite certain that a well grounded net-work of conductors will avert to a very great extent danger from lightning, but it is extremely likely that the same result is not attainable by the average rod that thrusts its point a few inches above the chimney top. It is well to remember that a few tall trees around a house form a very efficient and artistic system that is always well grounded and never needs overhauling.

A Monopoly Overthrown. THE decision in the case of the Augusta street railways given in our columns this week will act as an accelerator in the introduction of electric tramways in many towns which, like Augusta, have bound themselves over to a monopolistic system of street cars "propelled by horse, animal or steam power." The law, as laid down by Judge Roney, does not permit these words to exclude the introduction of electric roads, so that wherever there are exclusive charters containing similar provisions, relief from the bad management and dawdling always found in horse-cars free from competition, can be obtained by the introduction of electricity as the motive power of a parallel and competing road. The result must inevitably be a gain for the public and for electric railroading. This branch of the industry certainly has the gods on its side.

Another Conduit System. PERHAPS the most elaborate of recent underground systems is that described in our columns this week. The proposed conduit is water and gas tight, artificially freed of moisture, and provided with capacious manholes, large enough to admit of easy handling of the wires. It possesses many of the advantages of the tunnel plan that has been so often projected, besides individual merits of its own. Conduits cannot well be laid down helterskelter among gas, water and steam pipes without incurring the danger of frequent repairs, necessitating tearing up the pavement in a crowded street, and it would certainly be advantageous if some general scheme of work were found worthy of employment. It is encouraging to see that the ingenuity of inventors is being exercised, apparently with some success, to solve the puzzling questions raised by underground electric service, and to evolve a thoroughly practical system of subways.

An Artistic Plan for Electric Railways. PROFESSOR SWEET'S brief note on the arrangement of electric street railways will be read with interest by every one who dwells along the line of proposed routes. Where streets chance to be wide enough to stand the necessary reduction without interfering with the ordinary traffic, Prof. Sweet's plan would seem to be an admirable one. It would certainly beautify the street to have a smooth lawn 8 or 10 feet in width between the sidewalk and the curbstone; and it is a matter of no small convenience to the traveling public to be able to enter street cars without waiting at a crossing. In places where electric street railroads are about to be introduced the plan proposed is worthy of serious consideration, and it should be remembered that, although the streets would be narrowed by the change, it is quite likely that the removal of the track from that part of the roadway used for traffic would more than compensate for the decrease in width.

Thermal Storage Batteries. A SUBJECT that is in the air to-day, as the telephone was about twenty years ago, is the production of electricity by some more simple and economical means than the combination of dynamo and steam engine. Mr. Scheible's paper in this issue discusses very neatly the possible solution of the problem by means of chemical batteries. While the primary battery has a distinct, though limited, sphere of usefulness, every effort to make it an economical source of electricity on an extensive scale has met with failure. As Mr. Scheible points out, the fault is not with the efficiency of the battery, which, theoretically, is very satisfactory, but with the great expense of the materials from which energy is supplied. In spite of the fact that the total efficiency of our present systems, from coal to electrical energy, is less than 10 per cent., the greater efficiency of the battery has been in every case enormously overbalanced by the cost of the elements consumed. As was shown in a recent paper by M. Becquerel, the thermal batteries with melted electrolytes, of which there was much talk a few years ago, do not show any radical improvements over other primary batteries in which the electrolyte is a solution. Mr. Scheible, however, points out the possible availability of a distinctly different sort of battery in which heat serves the same regenerative purpose that the electric current does in a storage battery. In other words, it is a primary battery the application of heat to which restores the elements to their original condition, reversing the changes that have gone on in the production of the current. The suggestion, certainly, is a very interesting one, whether anything comes of the forms already devised or not, and points out a possible direction for future activity in the ininvention of electro-chemical generators.

An Important Consolidation. A NEW company has just been organized that will probably play a most important part in the development of storage batteries and storage battery traction. It is the successor of The Julien Electric Company, and in virtue of an option secured some months ago controls the important Brush storage battery patents. The title of the new-comer is The Consolidated Electric Storage Company, and it not only holds the four fundamental Brush patents under an exclusive license available for the full life of the patents for the United States, but also owns the Julien patents and other important rights covering methods of manufacture and distribution. It enters the field with ample financial backing, for the sole purpose of manufacturing and selling storage batteries on equal terms to all. The Julien Electric Traction Company has sold all its cars and traction rights to The United Electric Traction Company, which resulted from the consolidation with the Daft interests; but the new storage battery company has no contracts oral or written with any traction company whatever, and avows the intention of treating all comers alike, and pursuing a liberal policy. It believes that it can discourage infringements by underselling its competitors, owing to improved methods of manufacture; and it expects to push the storage battery with an energy that untrammeled as it will be by serious litigation should accomplish great results. It is a matter of satisfaction to see a fresh and vigorous start taken under such favorable auspices toward an end so much to be desired as the development and successful introduction of the storage battery. Electric traction will certainly feel the stimulus of cheapened and improved batteries, and the present corporation bids fair to infuse new vigor into a branch of electrical industry that has been seriously checked by the complicated litigations now for the most part ended.

Revision of the Patent System. A MOVE has recently been made toward the introduction of modifications in our patent law. It is suggested that it would be advisable to adopt something like the English system, so that the normal life of the patent would be five years, which term might be extended at its expiration by the payment of additional fees. It is thought that this plan would tend to decrease the present large number of unoperated patents, which only serve to hinder further improvements without giving the inventor the recompense for his work that the patent laws are intended to secure. Beyond question the present system can be greatly improved; but we doubt the beneficial results claimed for the proposed measure. The change would only complicate the work of the patent office without securing the desired end. It is highly probable that some plan by which unused patents should become void at the expiration of a reasonable period would serve to stimulate the invention of valuable improvements; but it is evident that the additional fee proposed will serve no useful purpose. It might sometimes cause the poor inventor to abandon a machine that had cost him years of labor; but it would not kill that great class of patents that are held for the purpose of preventing improvements, it would not prevent the suppression of patents held on an alleged royalty, and it would not check the career of fundamental patents in themselves useless, but held that the owners may enjoy the fruits of other men's inventive skill. It might result in injury to the man without capital to push his invention; but it would not interfere with the obstructive patents held by rich corporations. Besides, the Patent Office is making a large profit, which is hardly the province of a government department. If any extra fees are to be demanded during the life of a patent let the initial fees be reduced by at least an equal amount. Far better than the plan proposed would be some scheme by which, after the expiration of a reasonable time for introduction, all patents not in actual bona fide operation should expire by limitation. If the object of a patent law is to remunerate the inventor for his addition to the sum of national industry and resources, then his rights of monopoly should cease when he fails to avail himself of the exclusive privilege granted him and neither manufactures the patented article nor causes it to be put upon the public market.

NEW BOOKS.

Derivation of Practical Electrical Units. By F. B. Badt and Prof. H. S. Carhart. Pp. 56; 12 illustrations. Electrician Publishing Company, Chicago, 1890. Seventy-five cents.

This little book contains an intelligent account of the practical electrical units with which electricians have continually to deal, and is further enriched by brief sketches of the great men whose names have been attached to the various electrical units. To this is added a chapter on the modifications of the practical units, pointing out the changes that have taken place owing to recent absolute determinations of the units of the C. G. S. system, and embodying some of the recent changes in nomenclature. Confusion on the subject of electrical units is so common among students and with the general public that any distinct statement of the properties and derivations of these various quantities is a service in aid of the diffusion of electrical knowledge. The portraits of various great men in the history of the science are rather interesting, as, while the features of some are already familiar to most electricians, others are comparatively unknown.

Locating Electric Street Railways.

BY PROF. JOHN E. SWEET.

Much of our electric railroading, in fact practically the whole of the electric system so far, consists in substituting electric transmission for horse power, leaving the same road for the new power as for the old.

This came about naturally; but in the construction of new work, it does not follow that the old system is a necessity, and I believe it can be shown that a better arrangement can be adopted; better not only for the public, but for the stockholders as well.

First, it is necessary to state that the proposed arrangement applies only to streets almost or wholly occupied by residences; and especially for suburban towns.

The plan is to narrow up the roadbed to the least width that will accommodate the traffic. This, in all places where the new arrangement is proposed, need not exceed 14 or 16 ft. Set permanent curb stones and make from the top of the curb stones to the sidewalk a perfect lawn. Through the grass of the lawn on each side, run the rails of the electric road. This admits of the use of the bracket post system for carrying the overhead wire, if that system is used.

The advantage to the public is that they get rid of the rails in the roadway, which are a nuisance at best, and endured as a necessary evil in the case of horse cars. The roadbed is narrowed to a width that can be well paved for the same money that does it poorly at present. It costs less for repairs and keeping clean, gives less dust, and the wide lawns decrease the trouble from the dust that does fly. The cars can be reached without going into the streets, and the whole arrangement will be much more sightly.

The advantages to the railway company are, that though they may in the first instance have to pave the street, they certainly would avoid having to keep it in repair. They could for the same money use their high rails, and with high chairs, and get the ties well underground; thus getting a more rigid road bed, and one they could repair without interfering with traffic or being interfered with. They could use a rail that would not get covered with mud (which adds to the power required) and one that gives a better service by avoiding delays occasioned by impediments in the streets.

The disadvantages of the proposed system are, to the public, nothing that I can think of; to the company, only the short turn for the inside track, which can be overcome, as shown by sketch.

The cars going in the direction shown, would give sight room to prevent collisions at crossings.

The difficulty is to get the arrangement tried, and that can only be done by the company at first making a sufficient sacrifice to demonstrate its advantages, for it would be impossible to get even the neighbors of a single square to agree unless the company paid the expense.

After it is shown to be an improvement, then the citizens would acquiesce, even at no pecuniary advantage.

The objection likely to be raised by the people along the line, and the drift of the opposition, would be against the narrow roadbed. That a very narrow roadbed will accommodate a large traffic, if only the pavement be good, an hour's observation, either where there is traffic, or the same if spent in observing the street under consideration, will convince any man.

But the American idea of great show, regardless of quality, will render it difficult to get the consent of the people. As a matter of real beauty, a narrow, well-paved roadbed and two wide, well-kept lawns, make an infinitely better looking street than the wide, miserable pavement with gutters full of rubbish and grass strips too narrow to be worth attention, which is the common picture in rural towns.

The objection that will be raised by the stockholders will be that the change offers no immediate returns, unless the right of way can be obtained without any additional compensation to the corporation, in which case the cost of the road would be lessened to the extent of the usual cost of pavement. If the ruling spirit of some electrical road, where say a single square only is to be crossed, would offer to assume the paving and finishing of the street (except the curb stones), with the aid of a perfect picture, showing how the street would look, the chances are in favor of their getting the consent of the residents.

Should this much be accomplished, then a thoroughly good pavement (a little better than promised), perfectly finished lawns and elegant bracketed line posts, I believe, would so inaugurate the change that the balance of the line would be demanded, the residents laying their own pavement, so that the entire cost would be less, and the cost of maintenance of a wide pavement which the electric road has no use for would be avoided.

Should the trial ever be made, its success or failure will turn on the perfection of the roadbed for public traffic and the perfection of the lawns. The looks will at first have more bearing on the subject than almost anything else.

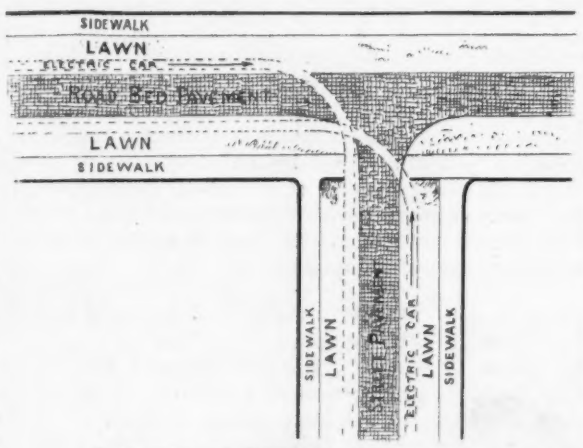
This may all have been thought out, tried and abandoned; but I hope I have given argument that is new and presented a thought that is valuable.

The Problem of Heat Cells.

BY ALBERT SCHEIBLE.

After all that has been said by the technical journals against the economy of electric lighting by primary batteries, they are still in the market for this and allied purposes. Where they are used for isolated plants, their costliness is admitted by the users; but at the same time firm after firm has claimed its batteries to compete with steam dynamo plants. That this claim allures subscribers to primary battery companies, even at this late day, seems to show something more than the survival of old notions among the people at large. This something is the faith of the public in the finding of some readily replaceable and very cheap elements for a battery.

Both the fluid and the so-called "dry" batteries have been brought to a state where they meet the everyday requirements of open and closed circuit work. The length of time during which a battery will give a fairly constant current on a closed circuit, has been increased in late years and is usually greater the more slowly the battery is discharging. Hence, for a long period of constancy the battery must be giving but a fraction of its greatest possible current in a given time. This means that for a given work we may use a large number of cells discharging slowly, or we may use a less number and recharge them more often. Another plan is the use of slow-discharge cells for charging a storage battery, from which the current may then be obtained at a greater rate per time interval than from the primary cells.



Location of Electric Car-Tracks.

In any case, we are met not so much with the question of first cost, as with that of cheaply recharging the exhausted cells. For storage batteries a dynamo current is used. Some dry cells, such as the Gassner, can likewise be recharged from a dynamo; and as these are slow-discharge cells they may last for many years. The energy of the charging current is that of the coal burnt to produce it, after subtracting the losses in furnace, boiler, pipes, engine, gearing, dynamo and wire. Ordinarily, four per cent. of the energy of the coal converted into electrical energy may not be a low estimate. This means that any other means of restoring the energy in a battery at 25 times the cost of energy in coal is as economical as the use of a charging current, other things being equal.

With primary batteries, the efficiency, *i. e.*, the energy furnished as current, in terms of that in the materials consumed, is much higher than the efficiency of a steam-dynamo plant. At first thought the electrical energy would be taken as equal to that of the heat of combination of the elements. But F. Braun, Czapski, Gochel and Jahn* have shown that the relation between the two depends on the individual processes in the cell. A given process may under varying circumstances, while causing the same heat of formation, produce different electromotive forces. It is true that for many of the common reactions the electrical energy produced is practically equal to that of the heat of combination, and may be calculated accordingly. But, as the above-mentioned German physicists have shown, this equality is not a general one, as Julius Thomsen† and others held it to be. Hence the theoretical efficiency of conversion is not in every case 100 per cent., though it may be very nearly as high. In calculating the working efficiency, as defined above, the known energy of combination of the materials consumed forms the starting point. W. Peukert* found the efficiency of the Daniell cell to be 47.7 per cent., that of a Bunsen 59.1 per cent. F. B. Crocker found a bichromate battery solution to have 45 per cent. efficiency, and thought that of a copper sulphate solution might be 80–90 per cent. His paper before the American Institute of Electrical Engineers two years ago† showed the possibilities of galvanic batteries, and the expense limit of cells as built at present. It emphasized the high efficiency of batteries as means of converting chemical into electrical energy, holding that 75 per cent. could easily be reached. Such figures would place the battery equal to the dynamo plant, if costing ten or fifteen times as much. But at present electric lighting from batteries costs 50 cents per horse power hour, against 2 cents for that from steam dynamos, or twenty-five times as much.

What makes the primary battery lighting so expensive is that recharging means renewing costly elements, a partial repetition of the first cost. The steam-dynamo plant may be wasteful of the energy in the coal, and hence in theory an expensive means of charging batteries; but it builds up the chemical separation in the elements as found in the exhausted cell. No new elements are needed, nothing but the energy of the current. The elements of the battery may well be costly, if its energy can be cheaply restored to it. Now, if the energy of the charging current is obtained at such a loss from that of the coal, why not use the energy of the coal directly? In other words, why not have the chemical separation in the cells produced by the application of heat to the exhausted cell? The possibilities of such a heat-cell, or "thermo-chemical battery," may have been dreamt of by many, though almost nothing has been published on the subject. Two years ago I wrestled with this problem, and as little seems to have been done since then toward solving it, it may be well for me to show what it implies.

The great requirement for a heat cell is a chemical action readily and perfectly reversible by heat. Since gases are very poor conductors, this reaction must take place in the wet, *i. e.*, either in solution or in presence of a conducting liquid. Then, too, the element which is to form the attacked electrode must preferably be a solid; although a liquid, separated from the solution either by the difference in their specific gravities or by a porous partition, would do. Such a reaction would probably meet the case. In looking for it whole classes of salts may be excluded for their known common properties, thus narrowing the search. Reversible reactions are not uncommon, but I found few which, on good authority, meet the other conditions mentioned above. Experiments with these few gave negative results, for reasons which, while more or less apparent, were not in the works on chemistry referred to. My work (‡) was confined to the more accessible inorganic salts, leaving both the rarer ones, and all organic compounds which may promise some fruits yet.

Mr. W. E. Case in his heat-cell (§) follows a different plan, the heat causing the reaction which produces the current. The double reactions applied in this cell were discovered by Sir Henri Loewel. They are the precipitation of metallic tin from a solution of $SnCl_2$ by $CrCl_2$, and the redissolving of the metal with formation of the original salts when the solution is heated to 140 degrees Fahr. Here the current flows during the short time while the first-named reaction is brought about by the heating. While the cell is cooling, there is probably a current generated by the combination of the CrCl with 2Cl: but as the former is in solution and thus in contact with the carbon electrode, this current cannot be utilized. But as this current still corresponds to a certain amount of heat applied to the battery, the theoretical efficiency of the cell would, in all probability, be much lower than that calculated by Mr. Case. Neglecting this probable great loss, as well as others due to radiation and local currents, we can look at the battery as a heat engine. As such its efficiency is $E=\frac{T-t}{T}$ where T is the higher and t the lower temperature limit, both reckoned from the absolute zero of temperature. This for a range of 80 degrees to 180 degrees F. gives 15.7 per cent., a very promising figure.

While several chemical thermopiles have been described in the electrical papers, this is the only true heat-cell that I have noticed, and I think one on the lines suggested would be more nearly ideal. If it has a greater temperature range it will have a still higher theoretical efficiency than the 15 per cent. just given. Even a rough approach to this in practice would make the heat-cell as economical as a steam-dynamo plant. Its other advantages for small "household" plants will suggest themselves. With the rapid unfolding of chemistry in its electrical phases, may not such a heat-cell be looked for?

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*Wiedemann's Annalen d. Phys. u. Chem., Bd., XVI., XXI., XXIV. and XXVIII., respectively.

†Original account of experiments in Poggendorff's Annalen. English abstract of same in *Scientific American Supplement*, No. 279.

*Zeitschrift f. Elektrotechnik, 1886.

†"The Possibilities and Limitations of Chemical Generators of Electricity." The Electrical World, May 26, 1888.

(‡) "Thermo-Chemical Batteries: A Study of the Conversion of Heat into Electricity through the Intervention of Chemical Affinity."—MSS. in library of Purdue University.

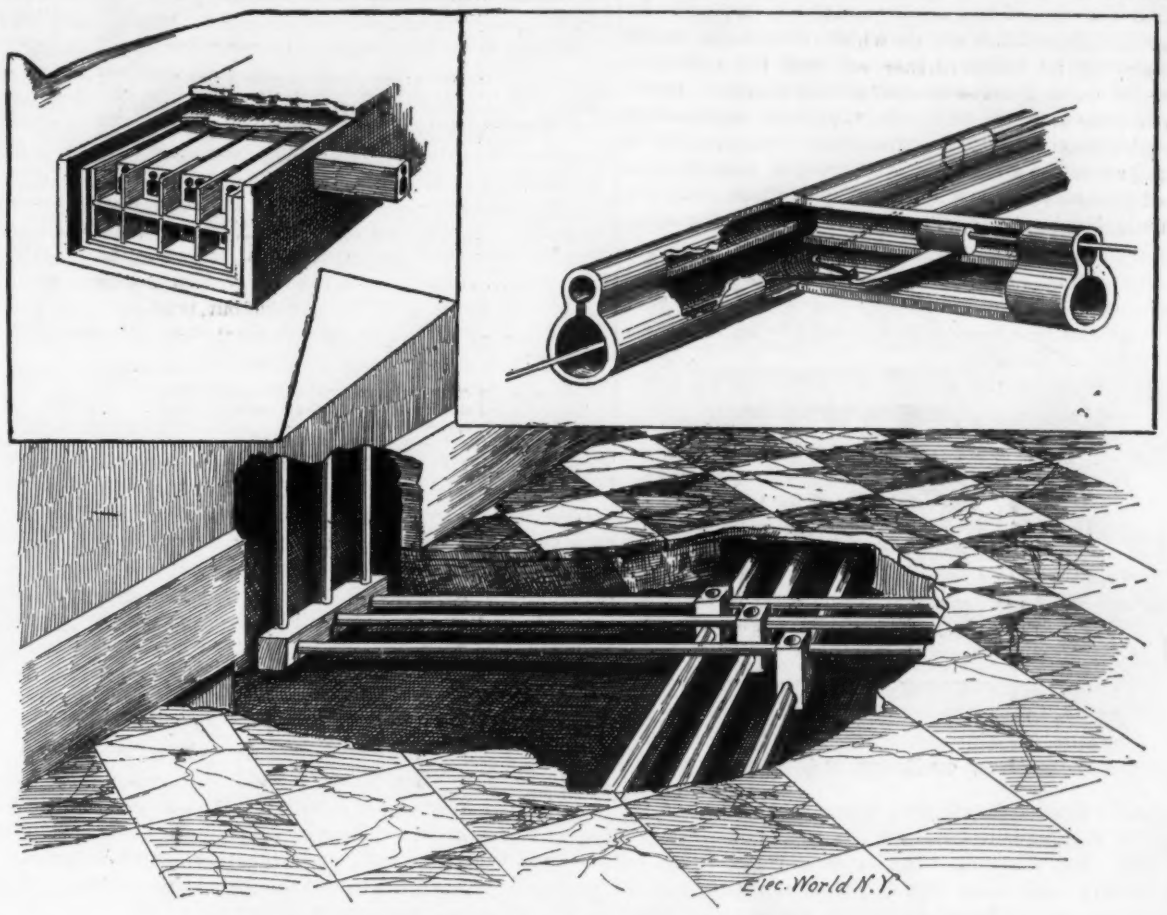
§Electrical World, July 17 and 24, 1886; Jan. 14, 1888.

The Munsie-Coles Conduit System.

Increasing demands for facilities for the running of electrical conductors in our large cities, to accommodate the rapid extension and development of the varied branches of the service, combined with the grave necessity of perfect protection to life and property, besides increased and justifiable antagonism of the public against the present overhead system of wiring, have caused the legislature and municipal authorities of different States and cities to enact laws compelling all electric conductors to be removed from the poles and put underground. The enforcing of these laws has a vital and important bearing on the future of electricity and its practical application to the needs and necessities of the public service. The development of electricity in the last fifteen years, as an agent in the practical commercial work of the world, has been of the most extraordinary character, and the public expect still more startling results in the next ten years.

If the public expectations in this line are to be realized, the underground system of wiring must be solved in a thoroughly practical manner; that is, the work of construction, repairs, renewals and extensions must be so arranged and simplified that the underground will be an improvement on the present overhead system; and that conduit and manholes shall be so constructed that they of themselves, independent of any insulation on the wires. will furnish as perfect protection against earth influences as the atmosphere between crossarms and surface of the earth in the air line.

The Munsie-Coles system has been designed to supply these indispensable features, and to give in practical application a subway that will give as cheaply as possible the use of a wire underground with as good service as overhead. In this system the conduits are constructed with an outer casing made thoroughly water-tight, preferably of prepared lumber creosoted, or asphalted to protect against decay. Within this casing is another, with a space between for insulating and waterproofing material. The ducts are arranged in the inner casing in a manner calculated to insure an even and perfect continuity of the chambers between manholes. These ducts are made of paper and wood fibre which the company guarantee to withstand the action of water and gas, and to be a poor conductor of heat. They are insulators of the highest order and not inflammable. The spaces between the ducts are filled with a dry insulating medium such as pulverized mica or a silicate. This construction is intended to prevent all infiltration of moisture and gases along the line of the conduit as well as at the manholes. The manholes, as shown in our illustration, are constructed with an outer wall and an insulated lining, and with a space between the two; the latter being filled with a hydrocarbon to protect against the infiltration of gas and moisture and to reinforce the insulation of the lining. The manholes have an upper and a lower chamber. The lower is for the high-tension currents, the low-tension wires in the upper chamber being protected by a metallic separator, which is grounded. The conduits for high and low tension are similarly separated, and if the earth between them should be in danger of drying out, the metallic separator could be run between the manholes so as to prevent induction. The manholes are entered from a side shaft covered with a perforated plate. Near the entrance to the battery wire chamber is placed a water-catch connected with sewer. Under this is a shelf and cup for unslacked lime or sulphuric acid; similarly at the bottom of the shaft is another cup with an air or ventilating pipe running to a street corner and elevated a few feet above the level of the curb. This affords a flow of air and prevents any accumulation of gases.



FIGS. 1, 2, AND 3.—MUNSIE-COLES SYSTEM—HOUSE SERVICE.

Thus it will be seen that this conduit by means of its usually high insulation, and because it is dry and free from gases, can be used for comparatively inexpensive wires, insulation being almost unnecessary. At the same time a long life is secured to the wires and a trustworthy service is promised, the saving here being sufficient to warrant any reasonable expense in constructing the mains. The round electric light ducts between the manholes are of a composite construction, with short sections of insulating pulp tube inserted. On entering the manholes they are hermetically sealed, and taps are placed upon them so that an air pump can be applied and a working vacuum made and retained, thus making still more possible the use of uninsulated wiring. The ducts are carefully constructed, and the only trouble that could possibly arise in any of them would be a clean break. If this should happen, and the lining tube be injured, the latter could be removed and another put in its place. The tube is got up especially to facilitate repairs and to make them cheap. The system is thus intended to interest the public as well as electricians, for it is claimed that with it explosions are impossible and traffic on the streets no longer interrupted, for the reason that repairs can be made without excavation.

For running single wires the Munsie-Coles system is especially advantageous, space being so economized as to make it distinctly a rival of the cable system in that respect, while construction work can be done so quickly and cheaply as to make it comparable to the overhead system. So also the company believes that for interior work its system is both cheap and effective, and that by it all trouble between manholes and buildings can be removed and necessary wires inserted without any difficulty whatever.

The working system by which these much-desired ends are to be accomplished is covered by a very complete set of patents, the specifications of which include almost everything in conduit matters from the manhole to the thirteenth story incandescent lamp. The duct for battery wires is constructed with a wire bed connected by a slot to a small upper chamber, which is intended to hold a permanent hauling rope between manholes. A single or twin wire can be run in at all times by connecting the wire guard to the hauling rope, a trailing rope being also attached in order to obtain working control of the guard and hauling rope. The duct can be run full of wires without trouble or danger of injury to any single wire.

The distribution ducts are placed on each side of the main longitudinal duct, and represent all classes of wires in the system. Electric light wires have the same arrangement as battery wires, and can thus be handled from manhole to building. Diverging ducts from basement of buildings to the uppermost stories are smaller in size, and

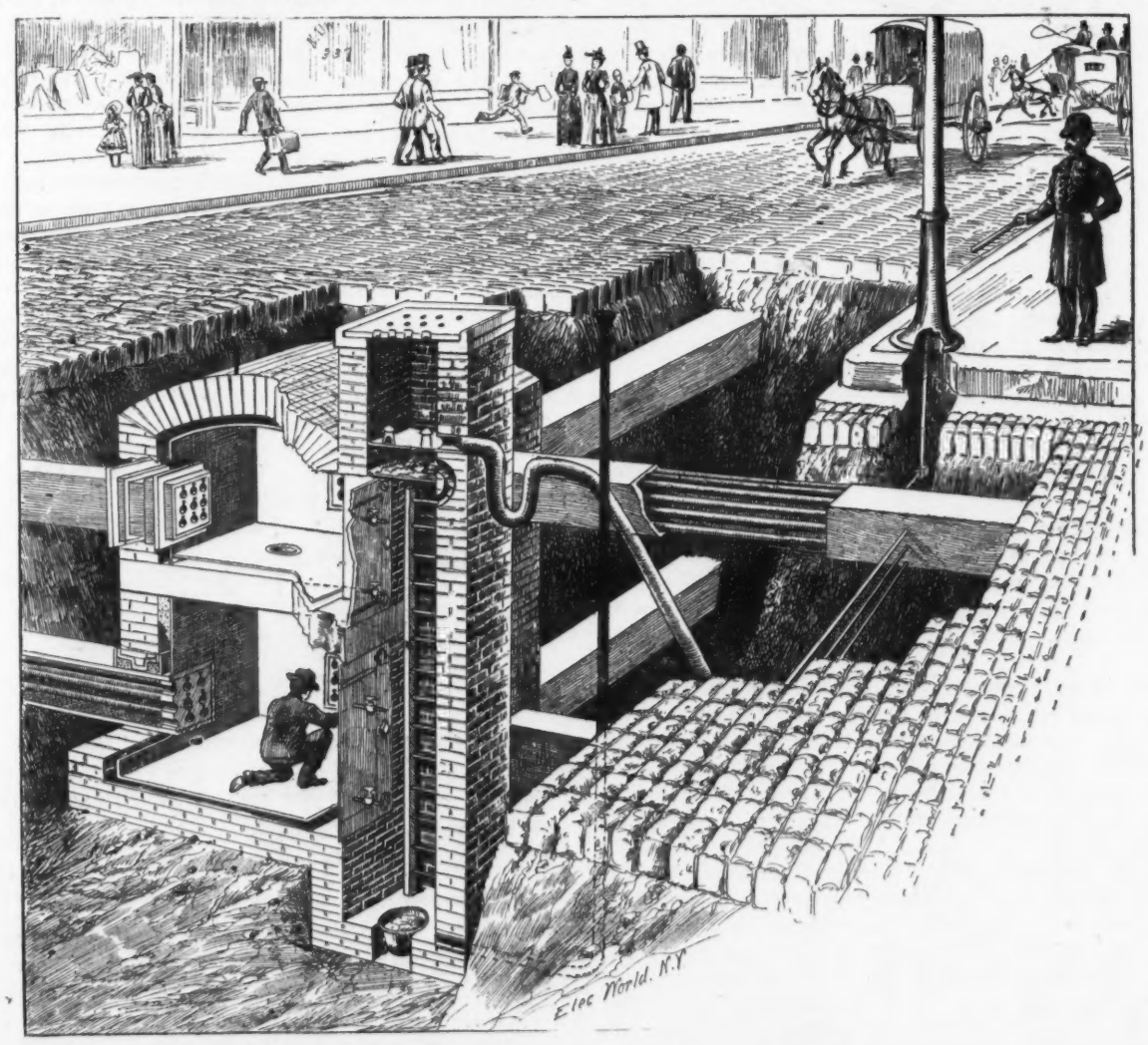


FIG. 4.—MUNSIE-COLES CONDUIT.—MANHOLE.

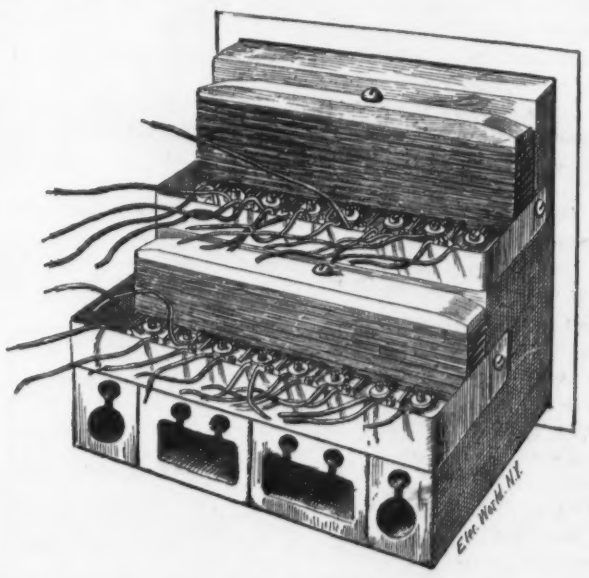


FIG. 5.—METHOD OF SEALING WIRES.

a different device is used for the longitudinal wire guide. This consists of a hook and a small friction roller which can be pushed from the basement along the diverging duct until it strikes the inner side of a longitudinal duct, when the longitudinal wire guide with service wire is hauled through. With these contrivances a wire in trouble can easily be drawn out and a new one put in its place. In the electric light conduit any individual circuit can easily be located by an ordinary lineman, and the testing of it can be done from one side of the manhole to the other, or from manhole to manhole, or from manhole to building or street line. The connections from one side of the manhole to the other side are arranged with flexible wires of increased cross-sections, and in addition there is a clamp which connects solidly the wire between the man-

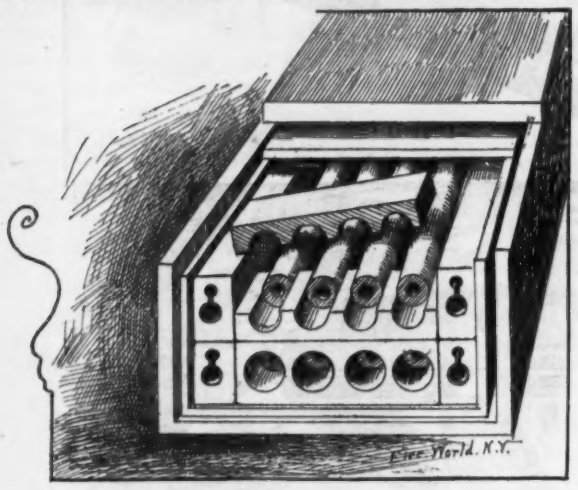


Fig. 6.—View of Ducts in Conduit.

holes to the flexible distribution wire. The clamp on the end of the flexible wire binds all the wires contained in it to a solid flat surface. The cross sectional view of each battery wire duct (fig. 5) shows the wires secured to binding posts on a board at the end of the sealed ducts. The binding board is surrounded by an edge rising as high or higher than the top of the binding posts or screws, which are covered with a hard rubber insulating tube with the number of the circuit stamped on each. To prevent crosses between the binding posts the board is covered over with a liquid insulator, so that in case of trouble on any circuit the lineman can unscrew the rubber cap of the circuit binding posts and can at once have the metallic connection to which to apply his testing apparatus. For interior conduit purposes the system gives control of all classes of wires. Repairs, renewals and all extensions can be made without delay or annoyance. All classes of wire are thoroughly separated from each other, thus reducing any disturbance from induction. The work after installation can be done without damage to the building, and the protection against fire is practically complete. No current, however intense, can cause ignition when confined in this composite fire-proof tube.

What is claimed for this subway may be summarized as follows:

1. A conduit constructed of insulating material and put

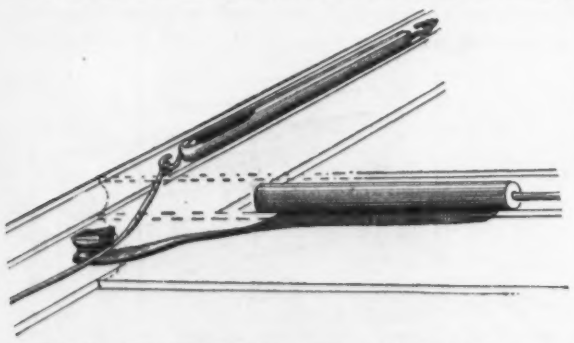


Fig. 7.—Drawing Cable into Lateral Ducts.

together to withstand infiltration of earth, gas and moisture.

2. A conduit so constructed that there can be no accumulation of gases or condensed moisture.

3. A conduit so constructed that the men can work among the wires without interfering or obstructing street traffic.

4. A conduit giving all facilities for single wiring, superior to overhead work, either in construction, repairs, renewals or extensions.

5. A conduit that thoroughly simplifies the work of locating trouble in circuits and assures an economical method of repairs and maintenance.

6. A conduit in which, when once laid, wiring under all conditions can be carried on between man-holes and buildings without opening the street; thereby assuring the municipal authorities against damage to paving.

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	.....	13,853
American	1,537	175
United States	632	6,141
Schuyler	1,066	.....
Ball	902	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	100	.....
Excelsior	205	30
Hockhausen	70	.....
Weston	138	.....
Fuller	10	.....
Reliance	80	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889.	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power; whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, Brother, will furnish non-illuminating gas for electric light engines.

Belt Strength.

BY ROBERT GRIMSHAW, PH. D.

The problem often presents itself how to figure out in a moment whether or not a certain belt is strong enough to carry a certain horse power at a certain speed. It is always well not to strain a belt, and sometimes there is not only danger of ruining the belt but a chance that breakage may work damage to business or property.

We will suppose that the belt is a leather one, running upon a cast-iron pulley. We know that the pull it exerts on the pulley is equal to the strain upon its tight "side," or fold, less that upon the slack side, or fold, and that this pull in pounds, multiplied by the belt speed in feet per minute, and divided by 33,000, will give the horse power. (This is assumed as correct. It is true, and there is no time to prove it now.)

Of course leather varies in strength; and no matter how strong the belt is, if the lacings or other fastenings are weak, the belt will be in danger. The greatest strain upon the belt, in pounds, is equal to the breadth of the belt in inches, times the thickness of the belt in inches, and times the safe working strain per square inch of cross section of the belt; this latter depends upon the kind of leather and upon its fastenings.

As to these fastenings, it is safe to assume, as the result of experiments made, that for ordinary single leather lacings the average breaking strength is 950 pounds per square inch; single rawhide, 1,000; double leather, 1,200; double rawhide, 1,400; and riveted joints, 1,750.

Of course the safe working stress in pounds per square inch will be less than this; and we may put them about as follows: Single leather lacing, 325 pounds; single rawhide, 350; double leather, 375; double rawhide, 400; and rivets, 575.

Working from this we find the square inches cross section of the belt to be for belts which are single leather laced 1-325, the greatest tension; where they are laced with single rawhide, 1-350; with double leather, 1-375; with double rawhide, 1-400; and where they have riveted joints, 1-575.

Thus, if we know that we are going to use a single leather-laced belt ¼ inch thick, and that it will have a force of 500 pounds on the pulley, and that the arc of contact will be 105 degrees, we know that the greatest strain on the belt will be $500 \times 1.93 = 965$ pounds; and dividing this by 325 gives practically three square inches of cross section needed. As the belt is to be ¼ inch thick, it would need to be $3 \div \frac{1}{4} = 18$ inches wide. If it was ¼ inch thick it would need to be only $3 \div \frac{1}{4} = 12$ inches wide; and if ⅛ inch thick, only $3 \div \frac{1}{8} = 9$ inches wide. For every arc of contact there is required a different multiplier; these are got from tables which have been calculated by correct theory and proved by accurate experiment. Thus, for 30 degrees arc of contact the amount of pull upon the pully is 0.189 times the greatest strain on the belt; for 60 degrees it is 0.2967 times; and so on, according to the following table:

Arc of Contact.	Multiplier.
30°	0.1890
45	.2685
60	.2967
75	.4082
90	.4673
105	.5181
120	.5650
135	.6098
150	.6494
165	.6803
180	.7143
195	.7409
210	.7692
240	.8130
270	.8475
300	.8772

This table (which is here published for the first time) is very convenient for ready reference when it is desired to know how much actual drive can be had out of a belt having a given breaking strength. Thus if we have a leather belt the safe-breaking strength of which is 1,000 pounds we may know that all the pull that it can be made to put upon a cast-iron pulley, with 90° arc of contact, will be $1,000 \times .4673 = 467.3$ pounds; but if the arc is 180° we will be able to get 714.3 pounds pull with the same maximum strain upon the belt.

The MacQuesten Electric Car.

It has recently been pointed out several times that the excessive gearing in use in electric motor cars seriously injures the efficiency of the system, and every effort is being made to deprive this objectionable feature of its unpleasant prominence. Besides this, it has often been thought desirable to connect the armature motor to the driven axle, not through rigid gear wheels, but through some more flexible method of connection that would reduce the sudden strains of starting, and, still better, allow

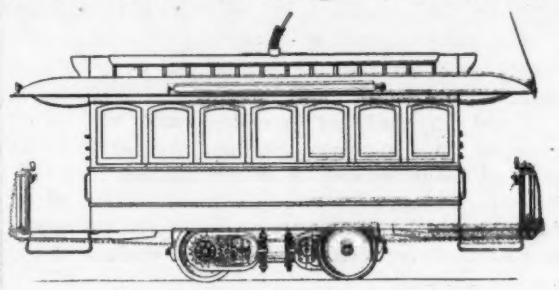


Fig. 1.—The MacQuesten Car.

the motor to run continuously and to gradually take hold of its load, so as to take advantage of the momentum already acquired by the armature and avoid the excessive flow of current which produces severe heating at the start. Both these ends have been rather ingeniously attained in the electric motor recently patented by Mr. W. D. MacQuesten, and shown in our cuts. It will be seen that this motor has its armature pinion working directly upon the gear wheel attached to the shaft, thus doing away with the intermediate gear now generally used. This of itself is a distinct advantage; but Mr. MacQuesten's very ingenious electrical clutch wheel shown in Fig. 2, gives him the ability to take hold of the load as easily and gradually as may be desired. The gear wheel with which the armature pinion engages is normally loose on the axle. It can be held fast by the clutch shown, which consists of a series of magnets radially arranged, their bases forming part of the common hub and their poles barely clearing the armatures, which are readily attached to the loose gear. The current that is supplied to this magnetic clutch can be nicely regulated so that in starting the car the clutch will gradually hold the loose gear from free revolution.

It will thus be seen that but a comparatively small amount of energy is needed to operate the magnetic clutch, and the moment the clutch is deprived of current the gear becomes loose on its axle, and the car can be stopped by its ordinary brakes; the armature still continues to revolve, consuming very little power and ready to furnish its energy of revolution to aid in the task of starting the car from rest. We shall await with considerable interest the appearance of the first one of these cars in practical operation,

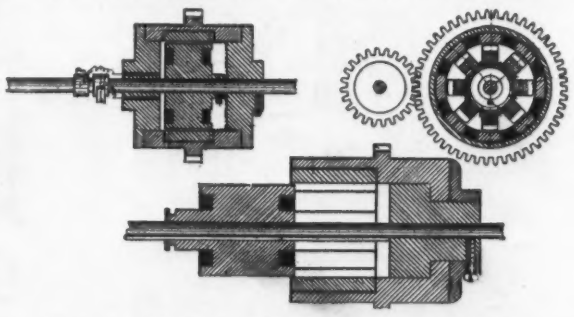


Fig. 2.—MacQuesten Gearing and Clutch.

for the motor geared down but once is a radical advance in constructive methods, and the magnetic clutch is certainly both clever and effective.

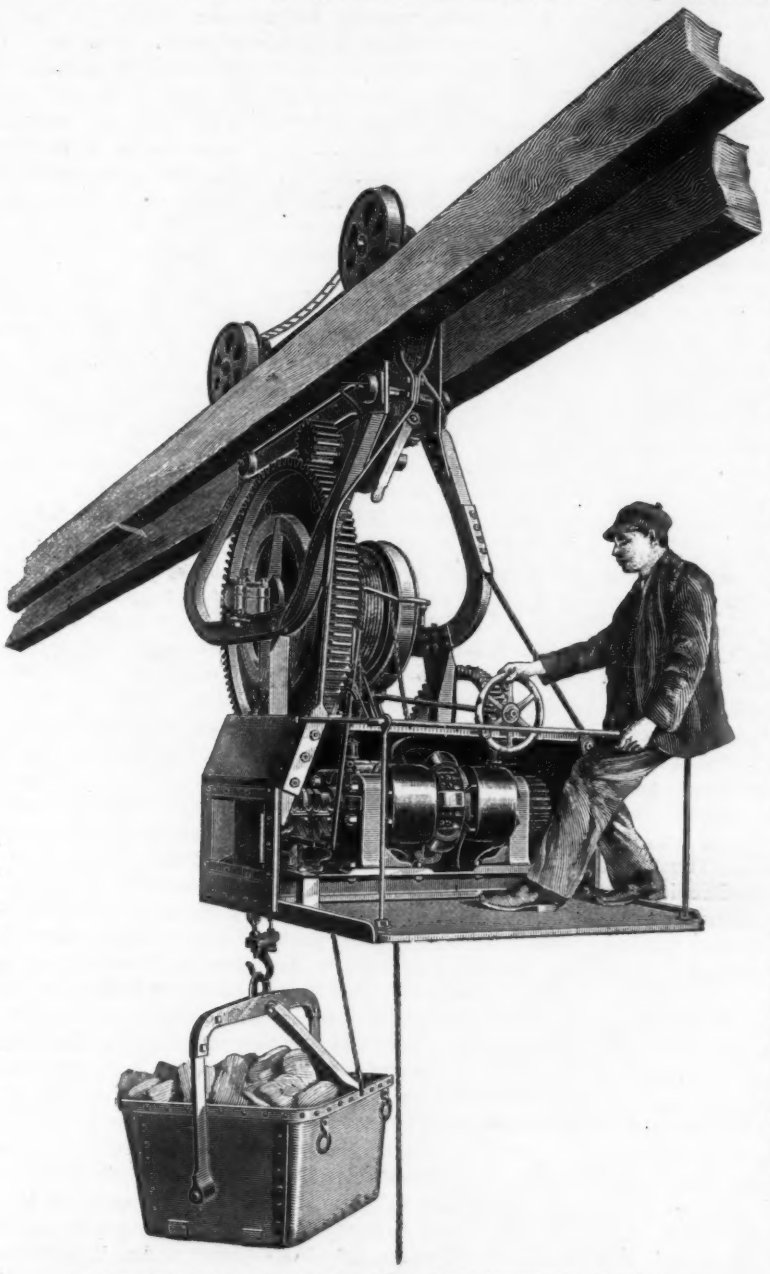
Electric Cars at Railroad Crossings.

F. F. Stanley, of the Stanley Manufacturing Company, Boston, has an automatic device to enable electric cars to pass over railroad crossings. Eight by eight-inch posts are set, a wire is drawn from one to the other on either side, to support the trolley-wire, leaving the space between for the gates. A tie extends from one wire to the other, at the centre, to prevent them from being drawn apart. The trolley wire is carried to the outer wire, then around the 8×8 posts, to the opposite wire, then across the track to the other pair of wires in the same way, thus giving a continuous circuit, but leaving a gap of eight inches for the gates. The trolley rod, to be used with this device, will have a second trolley wheel, standing on an arm a few inches in height, about 18 inches in front of the one now in use. The current everywhere on the line, except at the crossing, will be taken by the new wheel, the one in use being a few inches below the wire, out of the way of curves and switches; but, as the car approaches the crossing, the wire being carried much higher, the trolley rod takes a more

perpendicular position, bringing the back trolley-wheel up to the wire (it having being adjusted to just this height) to hold the rod in position, and keep the current, while the first is crossing the gap. The trolley wire, at this place, is to have a wide casting, similar to those used for switches; also to be covered by an inverted V-shaped trough all the way across the tracks, to guard against the jolting of the car. There is also a device to guard the ends of the trolley wires, and guide the gates in their places, and to prevent the lantern from swinging sideways.

An Electric Hoisting and Conveying Machine.

The applications of electricity in facilitating the ordinary operations heretofore performed by man or steam power are daily increasing, and a very useful and ingenious addition to their number is shown in the subjoined cut from a photograph of the actual apparatus. The machine is a special form of traveling crane, designed by F. L. Chamberlin, of Cleveland, for use in docks and railway yards, for the rapid unloading and loading of cars and steamboats. It will be seen that the whole apparatus, with the exception



CHAMBERLIN HOISTING AND CONVEYING MACHINE.

of the wheels on which it travels, is suspended from a pair of girders that carry the truck. This arrangement largely obviates any tendency toward spreading, and consequently there is no lifting of the load above the track and cross ties, but the apparatus works in just the same way as an ordinary light traveling crane. The load to be handled is carried in a bucket, which is hoisted under the traveling car and carried on the same hook, and which can be dumped in any direction at any point. The arrangement of the machinery is very simple and effective, which will readily be seen from the detailed cut. The motive power is a small Brush motor which operates the apparatus very successfully, giving almost no trouble and furnishing an abundant supply of power. The armature pinion acts through an intermediate gear shaft on the large toothed wheel seen in the cut, which, by means of a large friction clutch, operates the hoisting drum on the same shaft or through the medium of the small pinion above and the endless chain drives the car along the tracks. The whole machine is completely under the control of a single man, who can hoist the load, suspend it when hoisted, drive it along the track to the desired point and dump it in any direction with the greatest ease. There is no cumbersome gearing of cables to operate the machine or to furnish an unstable track. Everything is completely controlled and handled with the greatest rapidity and facility. It is a very ingenious and useful application of electric power, and shows the vast number of uses to which the electric motor can be put, and its immense convenience as a distributor of power otherwise available only through cumbersome and complicated means.

The Electrical "Ageing" of Alcohol.

After the crude material has been obtained, there are two stages in the process of preparing alcohol, namely, the rectification and the ageing. The method usually adopted for the latter purpose is to allow the spirit to remain several years in badly corked barrels. This naturally involves the storage of large quantities of spirit, and to overcome this disadvantage M. Teillard has adopted the Broyer-Petit electro-chemical method at his distillery at Tournus. The principle of this process, says the London *Electrician*, is to hasten the oxidation of the alcohol by exposing it to the action of ozone. To prepare the ozone two spirals of aluminum are arranged, one outside and one inside a perforated glass tube 1 centimetre in diameter and 45 centimetres long; around this tube is another one. The ends of the two spirals pass through the outer tube and are connected to the terminals of an induction coil. Oxygen is sent through the inner tube, and is exposed to the influence of a silent discharge between the two spirals. Great care is required in this operation. No sparks must occur, and the temperature of the apparatus must not exceed 15 degrees to 20 degrees C., or the ozone will be destroyed.

In actual practice the oxygen is passed through three such tubes in succession, the induction coils being worked by a dynamo giving 3 volts and 6 ampères. By this means 10 cubic metres (353 cubic feet) of oxygen is ozonized per hour. In addition to the dynamo, engine and boiler, the complete installation comprises an oxygen gasometer of 20 cubic metres capacity, six spirit vats, an oxygen pump and an alcohol pump. All taps must be of wood, all tubes of glass, all plugs of cork and the interior of the vats completely stripped of metal, owing to the energetic action of the ozone. In carrying out the process six vats are first filled with spirit. Oxygen is then passed from the gasometer over chloride of calcium to dry it, and is then passed through the ozonizers to a flask with three tubulatures, and thence through the six vats in succession to the condenser, where any vapor of alcohol taken up is deposited. The gas is then regenerated and used afresh. The volume of ozone required is about six times the volume of the alcohol treated, and the time required varies from five to six hours. Alcohol so treated is then stored in barrels, and after five or six months is ready for use.

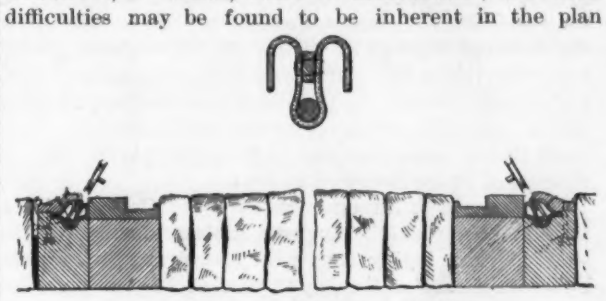
Batteries for Traction.

It was recently stated by Mr. Frank Wynne that he had found it impossible to obtain traction cells from whatever source that would stand more than 200 dischargings. This rather startling assertion, made in a pamphlet advocating a different system, was certainly laid open to the idea that disparagement of accumulators in favor of conduits was the aim of this remark. The London *Electrical Engineer* objected to it at the time, and says:

"We were more than surprised to find it also maintained by a well-known electrical engineer. It may be understood what such a thing would mean; for 200 chargings if used only once a day would mean the life of a battery for a tram car of little over half a year; while if charged twice a day, as often would be the case, this would mean a life of one-fourth of a year, or a depreciation of 400 per cent. per annum. This seems utterly ridiculous from what is known and published on the behavior of accumulators. But it was maintained that the data of people having to do with accumulators are persistently erroneous and misleading, and the truth with regard to storage is yet to be brought to light. These statements seem to require some investigation, and we therefore called upon Mr. Frank King, engineer to the Electric Construction Company, who now manufacture and supply the E. P. S. cells. Mr. King emphatically says that they have cells in practice which have given 450 dischargings. Even after this number of discharges the battery had only certain plates that required replacing, and the most part was in good condition. This is from actual work with traction cells, and there should be no difficulty in working the batteries for a year without repairs."

A New Conduit for Street Car Service.

The mechanical and electrical difficulties that have stood in the way of a successful conduit system for street car service are formidable—so serious, indeed, that thus far the conduit system has not met with the success which its very valuable features would lead one to desire; and, consequently, attention has been turned to various modifications of conduit and of railway service so arranged as to dispense with the overhead structure without at the same time having an open slot conduit. The latest comer in this field is due to Mr. W. J. Cordley, and is shown in the accompanying cut. The principle employed is a supply conductor inclosed in a small conduit of flexible material, and run, as shown, close alongside the track. The working conductor closes the flexible conduit at the top, and is normally unconnected with the main feed-wire. When, however, the contact wheels on the car press upon the working conductor, it is forced downwards into contact with the feed-wire, and a continuous supply of electricity is furnished to the car. As in other conduit systems, it is not safe to make predictions as to the advantages or disadvantages that will probably be found in this system. A rubber insulation is, of course, liable to deterioration, and other difficulties may be found to be inherent in the plan

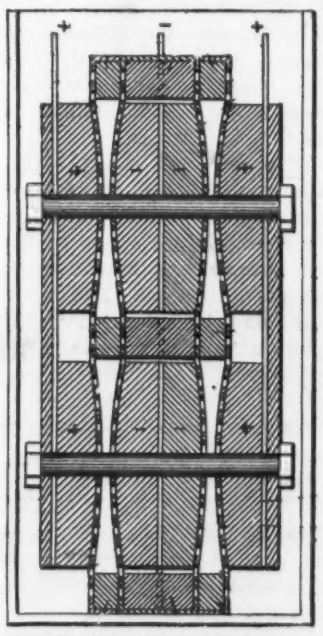


CONDUIT WITH FLEXIBLE WALLS.

of a conduit with flexible walls. Nevertheless, the idea of a working conductor normally out of contact with the feed-wire, and pressed into contact only when desired, is an excellent one, and unless on experiment the mechanical difficulties of arranging it should prove to be too formidable, we may make its acquaintance in actual use on the streets. Devices of this kind have very marked advantages over the slot conduit, and whoever successfully avoids the difficulties that have stood in the way heretofore will make a valuable addition to our present means of urban electric traction.

An Ingenious Secondary Battery.

It has been the constant effort of inventors to devise a form of secondary battery in which there should be a maximum amount of active material so placed as to be secure from the buckling that so rapidly causes the destruction of many of the varieties of plates now in use. The latest effort toward this end is a very ingenious one, devised by Mr. Carl Hering, well known to the fraternity as an expert electrician. The figure shows a vertical section of his battery, the simple type being exhibited, in which there are but two positive and two negative plates. The two outer plates are solid blocks of lead peroxide, such as may be made by mixing lead oxide in a solution of salts of lead, pressing the mixture in a mold and forming it into the shape desired. The two inner blocks are of spongy lead. Thus far there appears to be nothing especially unusual, peroxide of lead and lead being the elements ordinarily employed in secondary batteries. Now, however, comes the ingenious



HERING SECONDARY BATTERY.

part of the invention. These blocks of lead and peroxide are not fastened permanently to any electrode; they are simply held in contact with the contact plates of lead or lead alloy, which lie against the flat sides of the blocks of active material, and project as shown through the top of the cell. The means taken to secure proper contact are simple. Perforated straps of non-conducting material pass, as shown, over the exposed surfaces of both positive and negative plates, keeping the plates firmly in contact with the removable electrodes and at the same time keeping them apart from each other. It would appear that this form of cell would not be likely to buckle, and would be of reasonably light weight, although its internal resistance would probably be a little higher than in the ordinary forms. It is impossible to tell *a priori* just what service to expect of a given proposed form of secondary battery, but Mr. Hering's plan seems to possess some decided merits. It can readily be taken apart; a single plate can be removed, if injured, and another substituted

with very little trouble; and, in addition, it may be noted that the active material is formed in a block by itself, with which contact is afterwards made, instead of being mechanically applied to an electrode as in most of the batteries now used.

An Attempt to Exclude Electric Street Railroads Defeated.

An interesting case has just been decided by Judge Roney, of Georgia, in which an injunction against the electric tramways of Augusta is refused. The plaintiff in the case had the uncontested exclusive right to run cars in the streets of Augusta by "horse, animal or steam power;" but Judge Roney has refused to enjoin the building of roads for electric traction by the defendant company, holding that the plaintiff's monopoly cannot be extended so as to cover that means of transit. The following is an extended abstract of Judge Roney's decision:

The Augusta & Summerville Railroad Company in its petition asks that the Augusta Railway Company be restrained from laying tracks on any streets in Augusta. Plaintiffs claim that the City Council of Augusta passed an ordinance giving the plaintiff company "the exclusive right of way through and over all the streets in the City of Augusta, except Monument street," for street railroad purposes. That soon after its charter was obtained, the city council also entered into a contract with petitioner, giving to the company the exclusive right of way, through and over each and all of the streets of Augusta, except Monument street, and also the power to use dummies. That the Legislature in 1870 ratified the contract and ordinance of the city council, and provided, that the city council should not have the power to repeal the ordinance without the consent of the company. The answer of the Augusta Railway Company admits the passage of the ordinance, the making of the contract and the confirmation of the ordinance and contract by the legislature, but denies that petitioner has the exclusive right to the streets of Augusta. Further, if petitioner has any exclusive right to the streets of Augusta it is only for a street railroad to be operated by horse, animal or steam power, and that being limited to the use of that power only for running its cars, has no right to use or run electric cars, or to prevent defendant from operating electric cars in the streets of Augusta. That it was impossible for the city council or the legislature to have granted, or to have intended to grant to petitioner any right to use electricity, because at the date of the grant of the powers electricity was not known as an economic form of supplying power. That with no power to use electricity it is manifestly incompatible that it should have any exclusive right to use it, or that not being able to use it itself, it should prevent others lawfully empowered to do so. That the defendant, by an act of the General Assembly of Georgia, and by an ordinance of the City Council of Augusta, has authority to build, equip and operate an electric railway upon all the streets of Augusta.

The act to incorporate the Augusta and Summerville Railroad Company was passed by the General Assembly, March 20, 1866, "for the purpose of building and using, with the consent of the City Council of Augusta, a horse railroad in the City of Augusta."

Section 6 of the act provides, that the company may convey upon lines either passengers or freight, as the exigency of the business community and public may require. The act of the Legislature approved December 28, 1866, conferred the power to use dummy cars and engines to and from the terminus of the road. The ordinance of the City Council, September 7, 1866, granted "the exclusive right of way through and over all the streets in the City of Augusta, except Monument street, for the purpose of building a street railroad . . . . . in and along the streets of the said City of Augusta, and to use, own and occupy the same, and to keep, maintain and operate thereon railway cars and carriages, to be drawn by horses or animal power, except upon their main line along Broad street, which may run by dummy cars." . . . On Sept. 24, 1866 the city counsel of Augusta entered into a contract with the company, which recites that "whereas the General Assembly of Georgia, by an act approved March 20, 1866, incorporated the Augusta & Somerville Railroad Company, for the purpose of building and using, with consent of the city council of Augusta, a horse railroad;" . . . and grants to the company "the exclusive right of way through and over all the streets of Augusta, except Monument, and authorizes them to construct their lines and to operate thereon railways cars and carriages to be drawn by horse or animal power." On Dec. 26, 1870, the legislature passed an act amending the charter of the company, and also confirmed the contract and ordinance above recited of the city council made and passed in behalf of the company. From the grant of powers above quoted rest the claims of petitioner's company.

The act of the Legislature of December 26th, 1870, is constitutional, and the powers conferred by the legislature and the city are binding, and must be enforced by the courts. That the powers granted are exclusive cannot be denied, but whether they extend to the limits claimed by petitioner, we must resort to the construction the law places upon such grants or contracts. The proper rule for the construction of legislative grants, is that all rights asserted against the State must be clearly defined and not raised by inference or presumption; and if a grant or charter is silent about a power, it does not exist. If, on a fair reading of the instrument, or contract, reasonable doubts arise as to the proper interpretation to be given it, these doubts are to be solved in favor of the State; and where it is susceptible of two meanings, the one restricting, the other extending, the powers of the corporation, that construction is to be adopted which works the least harm to the State.

Exclusive grants or monopolies are neither the favorites of the courts nor the people. Nothing is to be taken as conceded, but only that which is given in the plainest and most unmistakable terms. "Silence is negation, and doubt is fatal to the claim." "Possession," says a learned judge, "by one individual of a privilege not open to acquisition by others, apparently conflicts with that equality of rights, which is the underlying principle of social organization and popular government. He who claims such exclusive privileges must show clear warrant or title to the same." Such grants then must be construed strictly, and nothing will be taken by implication. In a country like ours, constantly advancing in wealth and prosperity, new channels of communication are daily found necessary for travel and trade, and are essential for the comfort aad convenience of the people." Let it once be understood, says the Court in a well considered opinion in 11th Peters, 422. "that exclusive grants carry with them implied contracts, and we shall be thrown back to the improvements of the last century and be obliged to stand still, until the claims of the corporations are satisfied, and they shall prevent the States to avail themselves of the lights of modern science, and to partake of these benefits, which are now adding to the wealth and prosperity and the convenience and comfort of every other part of the civilized world." Construing the powers of petitioner's company it will be well to remember, that it is contended by the defendant that they do not conflict with their rights. That in any possible event, the grant of the exclusive right of way for the purpose of building a street railroad to operate cars thereon to be drawn by horse, animal or steam power, does not prevent a subsequent grant to use electricity. In support of this view the following cases are cited:

In the Omaha Horse Railway Company vs. the Cable Tramway Company, 30th Fed. Report, p. 324, the Court says: "In 1867 plaintiff's company by its charter was given the exclusive horse railway franchise of Omaha for fifty years. Defendant's company, under a city ordinance, consented to by the people in 1884, authorizing it to do so, undertook to lay a cable tramway in Omaha on streets occupied by the plaintiff, who sought to enjoin the defendant, contending that at the time of grant, 'horse railway' meant street railway (cable roads being then unknown), and therefore, its grant covered that form of railway communication. The Court denied the injunction. Held no error by the Circuit Court of Nebraska, since all grants of franchises belonging to the public being strictly construed against grantees, a fortiori, those giving monopolies should be so construed and Courts would not enlarge them by implication."

In the case of Teachout vs. Des Moines Broad Gauge Street Railroad Company, Northwestern Reporter, 145, the doctrine is laid down that a street car operated by animal power does not impair the right of another company to operate electric cars. In that case the Court held that a city ordinance which confers upon a company power to construct street car lines, and to provide that "such tracks shall be operated with animal power only," and that the city shall not until after thirty years "confer upon any person or corporation any privileges which will impair or destroy the right and privilege herein granted," does not preclude the city from granting another company the right to operate lines by other means than animal power.

Exclusive franchise to a company to light a city by gas does not prevent giving subsequent franchise to another company to light by electricity. Saginaw Gas Light Company vs. City of Saginaw. 28th Fed. Rep., p. 529.

An exclusive right to supply "light or heat" to a city does not prevent a subsequent grant to a company to light by electricity. 16th Atl. Rep., p. 426.

Charter provision that no other bridge shall be built across a river, or ferry allowed, does not prevent the Legislature authorizing a railroad bridge. 1st Wall, p. 116.

Exclusive right to a corporation to supply water to a city will be construed so as to give no greater monopoly than its terms clearly indicate. The right to supply water from a certain source did not prevent competition from another source. 34 Fed. Rep, p 145.

Exclusive grant to build and maintain a bridge for five miles up and down a river does not prevent the Legislature from authorizing a railroad bridge. 25th Ga., 445. In addition to these authorities we also cite 3d Wall, 74; 24th Fed. Rep., 306; 28th Fed. Rep., 529; 73d Iowa, 513; Code of Ga., 5025; 9th Ga., 412 and 480; 7th Ga., 221; 49th Ga., 201.

In the light of the foregoing authorities, we conclude that the exclusive rights of the Augusta and Summerville Railroad Company extend to operating their cars upon their line of roads by horse, animal or steam power, but to nothing more; and that the defendant's company will not impair that right by operating on any of the streets of Augusta an electric system of railroad.

The Management of Accumulators.—IV.

BY J. K. PUMPELLY.

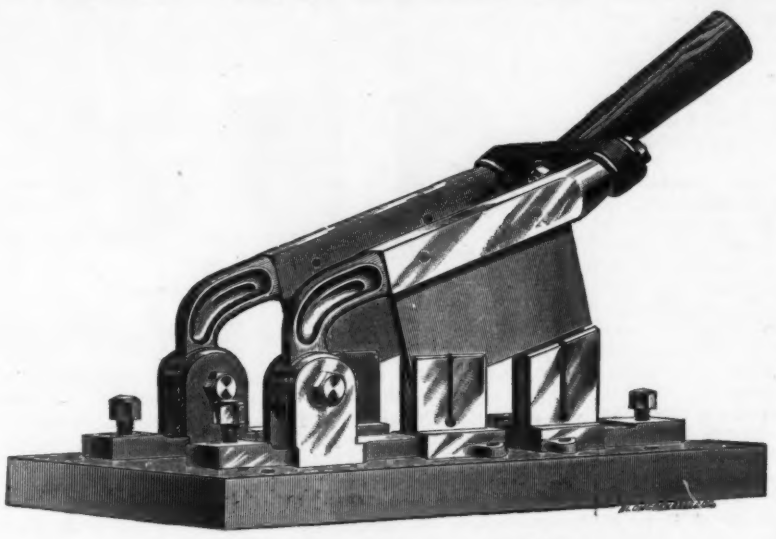
It was discovered by Planté, and by the experience of others since, that many more hours of discharging are needed to convert the positive plates into a peroxide of lead than to change the negative plate into finely divided lead, which is evidently the process necessary, as far as practical results go, to make the battery efficient to its full capacity. To do this, one or two charges and discharges are necessary, so that in reality we cannot expect to obtain our estimated percentage of efficiency until this forming work has been done, by the current of electricity put into the battery and taken out of it. Let us suppose now that this has been done three times consecutively, then we make our test trial. We have the thirty batteries and a series of ten 60-volt lamps connected, and we find that these ten lamps are burning well up to candle power for seven hours; that is, seventy ampère hours have been consumed, and the voltage of the battery stands at 58 volts. Hence the lamps will burn two hours and a half more, making 95 ampère hours of useful work, but not with as high candle power. Now we find it best to take off the lamps, leaving about 20 per cent. of the charge still in the battery. This method is preferred, as it seems to prevent the action of the sulphuric acid directly on the lead plates, and also shortens the time of the next charge. Now we charge again with a current of 20 ampères, and find that after five hours' run in discharging on twenty lamps we have about the same efficiency as before. Again we increase the charging current to twenty ampères, and the discharge to thirty lamps, and find a slight loss in our heretofore fair percentage. Hence we conclude by experience that a twenty-five ampère charging current is sufficient for a 100-ampère hour battery, and the discharge is not economical over the rate of twenty ampères per hour. This rate of charge and discharge we will call normal. A larger rate of either we will consider maximum. We get quicker work, which is supposed to be needed, but not so economical as to efficient percentage. If it should happen that the charging current was not cut off at the end of five hours, the current that still flowed through the battery would be of no good nor do any harm. It would be like splashing water over the top of a tank after it has been pumped full.

In watching our next charging, we may find that one cell in the series does not act like the others. The surface of the electrolite remains quiet, and no bubbles appear on the surface. We try the voltmeter on the circuit and find that we are two volts short; instead of a fraction over 60 volts we have but 58. We must try every cell, using the double reading on our Weston voltmeter, which is divided into thirtieths and has a double-pole standard, or connection fastening one wire to the small standard and one to the larger one. This will give us the reading on the lower line for two or four volts and thirtieths of a volt. Now we must find out, by testing each cell for voltage, where the loss is, testing along the line thus, with two insulated wires, the ends of which are attached, one to the north pole of the voltmeter, and one to the south, and the other two ends cleared of the insulation and slightly sharpened. We touch the two poles of each cell, and find, after several tests, that one cell in the series shows a very low voltage; here must be the trouble; and after closer examination we find a contact between the plates in the battery which actually short-circuits it, and merely allows the current to pass through to the next cell, the same as if the two poles were fastened to a wire reaching across to the next cell. We must take this cell out, and as it is behind the others in the charge, must wait until they are all discharged. Then, after separating the plates, begin anew with the others. If we do not take this precaution, we shall find this cell unequally charged, and thus a drop in our E. M. F. before the battery has done its estimated work. However, when a battery is well formed and equally charged and discharged for a few days, this seldom happens until the batteries have been in use several months. But it does happen with nearly all the styles of batteries now made, and it is impossible to tell when it will take place, especially if the work the battery is forced to do demands, at times, a discharge in ampère current much over normal, that is 70 or 80 ampères, the tendency being to bend and twist the plates, and thus bring those of opposite poles together so that they touch. This uncertainty is what throws a shade of hazard over the calculations of those using such storage batteries, and is one of the strong objections to placing them in work demanding certainty of performance. Every effort is now being made to make batteries in such a way as to avoid this, but the writer is strongly of the opinion (and practice for one year bears him out in this) that it cannot be done unless the plates are prevented from touching each other, under any strain of work, by some fibrous absorbent that will not disintegrate in the acid nor increase the internal resistance. This the writer has accomplished, so that short-circuiting, that is buckling, cannot take place.

In order to gain this advantage the writer departs from the general mechanical method of building the batteries. Heretofore the plates in all batteries have been placed in an upright position in the cell, face to face and depending entirely upon their own atomic tenacity to hold together. Strips of hard rubber or small buttons of the same materia

are placed between the plates to prevent their touching each other. This method of separation often fails, especially when a heavy current tends to buckle the plates. There is also a constant tendency in the active material to flake off, or even to fall out and be held between the plates, thus short-circuiting the battery; also a danger from trees of lead, or specular crystals of lead, which form between the plates, and produce the same deleterious action, and which can not be prevented or guarded against. These crystals are very fine, almost needle-like and imperceptible. Another trouble shows itself when the plates are most active. The positive ones become very porous and spongy, and then they fall apart and disintegrate and the cell is ruined.

The method of building batteries, mentioned above as being an exception to the rule, is this: The plates are placed one over the other, horizontally in the cell, the positive all held together by strong lead lugs, which are cast on each plate. These lugs are hollow and tapered, and



SWITCH FOR HEAVY CURRENTS.

are pressed into each other firmly. The negatives are treated in the same manner. Through this continued lug a heavy copper wire is run and molten lead poured down the lug and around the copper, thus making a firm contact, both chemically and mechanically. Then the two sets of electrodes are slid together, and a peculiar kind of cellulose fiber is placed in thin sheets between the electrodes. This fiber absorbs freely, is a non-conductor, and is of so small resistance to the passage of current or the gases formed in decomposing the water, that it cannot be detected, either in practice or by test. The fiber is of great durability in the acid, and is just close enough in its mesh to prevent any minute material from passing or washing through from one electrode to the other. Thus the plates being supported and feeling no strains that might tend to disintegration, last much longer than other forms of battery, and when, in the course of two or three years, the positive plates may need renewing, the old ones can be drawn out, and an entire new set slid in.

It is found that the copper wire, imbedded in the lug, carries a larger amount freely, and a discharge of 80, 100 and 125 ampères does not disturb the plates.

An Improved Switch for Central Stations.

Our cut shows an improved form of the Andrews type of main line switch for central station or isolated plants. These switches are specially designed to carry heavy currents of from 100 to 3,000 ampères, and the fact that the makers, J. Lang & Co., of Chicago, have placed them in numerous central stations throughout the country is an evidence of the effectiveness of the design. The contact is instantly made and broken across the entire face or width of the copper clips, instead of being gradually drawn off to one corner, as is the case with many of the switches now in use. By this means the switch is easily manipulated and sparking is reduced to a very small amount. The clips and tongues in these switches are made of the purest copper, and the body parts are cast in composition metal of as high conductivity as practicable. The tongue is hung loose in the holder so that it drops into a parallel fit with both sets of clips. The closing and opening of the circuit is complete and instantaneous. These switches are made either on slate or mahogany bases and the workmanship is of the most finished character.

The Beck Twin Compound Engine.

The accompanying illustration will give a very fair idea of the "Beck" twin compound engine, which is an important departure from the old lines, and embodies features not found in other engines of its class. It is patented by R. M. Beck, and is manufactured by the Taylor Manufacturing Company, Chambersburg, Pa., whose New York office is at 22 Cortlandt street, and is made for electrical plants in sizes from 50 to 500 h. p.

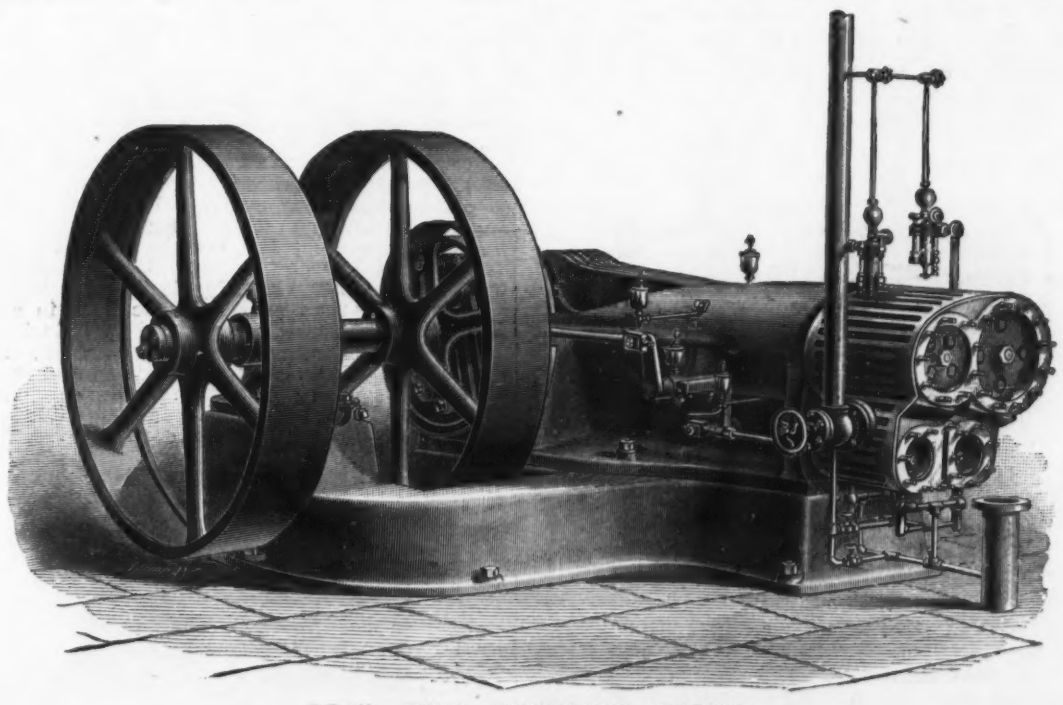
Instead of placing the cylinders one in front of the other, they are here placed side by side, with one common wall between. The two pistons are attached to a common cross-head which is connected to a crank pin by a single conecting rod. The valve chambers are placed side by side beneath the cylinders with a chamber between them into which the exhaust steam from the high-pressure cylinder is discharged through the port or opening between the valve chambers; the cap or bonnet, which is placed on the end of the valve chambers, serves as a connection between the end of the valve chamber of the high-pressure cylinder and the port of the receiving chamber. Each end of the chamber is fitted with a bonnet, thus making a very short distance for the steam to pass from the ports of the high-pressure cylinder to the chamber, whence it passes to the valve chamber of the low-pressure cylinder, and thence into the cylinder proper, where it exerts anew the expansive power still remaining after having done its work in the high-pressure cylinder.

The short distance the steam has to pass through from one cylinder to the other prevents loss of pressure from radiation of heat. The wall or side of exhaust receiving chamber next to the valve chamber of high pressure cylinder is exposed to the live steam from the boiler before it enters the high pressure cylinder, and thus helps to prevent loss of heat from the exhaust steam in the chamber. Still further protection is afforded the exhaust steam by passing it though the hollow piston valve of the high pressure cylinder, which is surrounded by live steam from the boiler preparatory to being distributed into the high pressure cylinder. The exhaust chamber is also of such proportion as to receive the steam without back pressure; and unnecessary expansion of the steam before entering the low pressure cylinder is prevented. The economy secured by this arrangement may be seen from the result of a test recently made by the makers at their shops with an engine of 8 inches diameter of high pressure cylinder and 13½ inches diameter of low pressure cylinder, with 15-inch stroke. In a 15-hour test this engine developed 90 h. p. per hour on 2 pounds of coal and 24 pounds of water per h. p. per hour, with boiler pressure of 100 pounds. The same engine in a test of same duration developed 40 h. p. on 2¼ pounds of coal and 27 pounds of water per h. p. per hour, boiler pressure 100 pounds. In an 11-hour test it developed 25 h. p. on 3 pounds of coal and 35 pounds of water per h. p. per hour, boiler pressure, 100 pounds.

The last-named test is with a very light load; consequently the economy is not so good as with full load, but under the circumstances the results are as flattering as with the maximum load. The coal and water used in the tests were ascertained by the actual weight and measurement of same as supplied to the boiler.

The tests were made with common return tubular type of boiler with plain setting, using good bituminous coal from the Cumberland regions. Feed-water was at 208 degrees temperature, and all live steam pipe was covered.

The valves of the two cylinders are operated by one eccentric or governor which is the same as used on the plain



BECK TWIN COMPOUND ENGINE.

engines, and through it as high efficiency in regulation is secured as in the well and favorably known single cylinder engine. By the use of only one eccentric or governor, the travel of each valve is varied to meet the changes in load, and thus distribute the steam to cylinder in proper ratio to obtain ease and smoothness of action, a feature that is rarely secured in compound engines, and the strain on each piston is properly equalized.

Plain types of single cylinder engines of any kind can readily be changed to compounds by simply putting on new cylinders.

These compound engines are designed for electric light and street railway service as well as for other purposes especially marine, for which service a line of vertical engines is being designed, the advantages of compactness being important in marine work, particularly for yachts They require no more space than an ordinary engine. They have no large receivers nor live steam superheating attachments, but are as simple as a single cylinder engine and therefore can be handled by any engineer of ordinary intelligence.

Storage Battery Law.

To the Editor of the Electrical World:

SIR: Will you kindly answer the following questions: Did Judge Cox hold, in the suit of the Brush Electric Co. vs. the Julien Electric Co., that the Brush Electric Co. were entitled to the broad claim of the secondary battery electrode in which red lead as an absorptive or active material is used? (2) Did he confine the Brush Electric Co. to the use of red lead in the secondary battery electrode applied in the form of paint, powder or cement as a broad claim, or did he confine them to their special *modus operandi*? (3) Is not the application of red lead to the electrode of a second battery in the form of a powder common property? LAYMAN.

[(1) The broad claim of the Brush Electric Co. is to the mechanical application of the active material to the electrode of the secondary battery. (2) The Faure patent was confined in a previous suit to application of the active material as a paint, paste or cement, this claim being a special case of the broader claim of the Brush patent for mechanical application. (3) The mechanical application of red lead in the form of a powder seems to fall under the Brush claim, as decided in the case you cite. The Planté method of formation by action of the current on lead for a long time is the only method of forming a secondary battery which can be considered common property.—ED. E. W.]

Accumulators for Bicycles.

To the Editor of The Electrical World:

SIR: Will you kindly answer the following questions and favor me with any advice on the subject that may be of service to me? 1. Have storage or primary cells, with motor, been successfully adapted for driving bicycles? 2. Is it at present possible so to use this power, and what would be about the weight of accumulators and motors sufficient for driving a light bicycle for one person 25 or 50 miles, without recharging? 3. What secondary battery or motor now on the market would be of most service, if the thing is practicable? 4. If any primary cell can be used, what one would you suggest?

SUBSCRIBER.

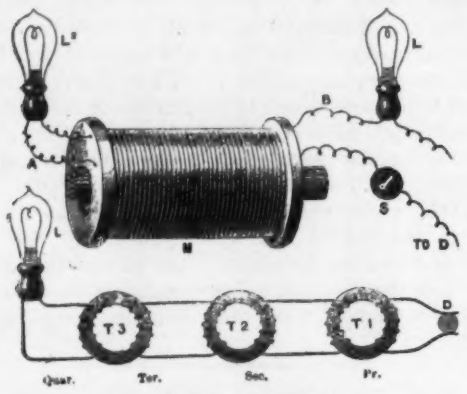
1. We are not aware that bicycles have been driven with any success, or at all, in the method you mention; but divers experiments have been made with electrical tricycles operated by motors and accumulators. Fair success has been obtained. Probably Mr. M. M. Slattery, Fort Wayne, Ind., who has worked considerably along this line, can give you valuable information as to details.

2. It is possible evidently to drive a tricycle by electricity. As to the weight of the accumulators that must be used, the amount would vary according to the distance to be traversed. The weight of the accumulators will be about 100 pounds per horse power hour of output, and the distance which the tricycle can be operated by any given battery would, of course, depend almost entirely upon the condition of the road. Fifty pounds would probably cover the weight of the motor, and a machine even lighter could be used, if necessary. 3. Select the lightest battery, other things being equal. You will obtain details of performance and output of secondary batteries by writing to the makers. As to motor, it would probably be desirable to have one of ¼ to 1 h. p. specially wound for the purpose, which could be done by any of the firms that make small motors. 4. We would not advise you to try to use primary batteries, on account of the trouble in caring for them, and their usually high internal resistance. You would probably get as good and certain results from large flat Grove cells as from any battery with which we are acquainted. These cells, however, should be of extra large size in order to secure reasonably low internal resistance.—ED. E. W.]

Prof. Elihu Thomson's Electromagnetic Induction Experiments.*

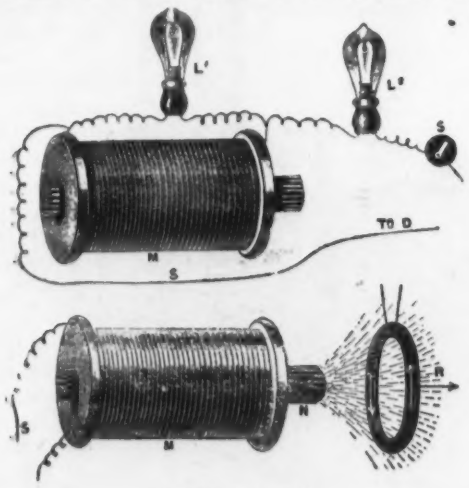
BY J. A. FLEMING, M. A., D.SC., M.I.E.E., PROFESSOR OF ELECTRICAL ENGINEERING IN UNIVERSITY COLLEGE, LONDON.

"I. In the Paris Exhibition of 1889, and in the United States Court, many present will, perhaps, recollect to have seen a collection of electrical apparatus, contributed by Prof. Elihu Thomson as his private exhibit. These pieces of experimental apparatus constituted the appliances for illustrating some highly remarkable and interesting facts in electromagnetic induction. It is more than probable that very many persons interested in electrical discovery either did not find, or did not happen to see in action, these instruments, or perhaps had not the opportunity to see them at all. By the kindness of Prof. Elihu Thomson, to whom I am indebted for the loan of the apparatus, it is in my power to repeat some of these experiments before you to-night; and my obligations are likewise especially due to



FIGS. 1 AND 2.

Mr. Ernest Thurnauer, the engineer of the European Thomson-Houston Electric Light Company, for affording me his valuable aid in bringing them before you, and to Mr. Garfield, of the Thomson Electric Welding Company, for assistance in preparing the experiments. A few introductory remarks will be essential, in order that I may carry the whole of my audience with me in subsequent explanations; and these remarks will refer to that which is so very familiar a subject to every electrician, viz., the mutual induction of electric circuits. Before me lies a very large bobbin, or spool, wound over with two insulated copper wires. These wires were wound on the spool together, and for convenience' sake we will distinguish them by calling them *A* and *B* (fig. 1). Bear in mind that the wires or circuits are insulated from each other throughout their entire length, but lie closely adjacent on the bobbin. I can at pleasure insert a large bundle of soft iron wires tied up together into the hollow split brass tube which forms the body or the spool. The ends of one wire, say *A*, are connected to the terminals of a glow lamp, and I can pass or interrupt an electric current which traverses the other circuit, *B*, and a second glow lamp in series with it. You will note at once what happens when I start or stop the electric current in the circuit *B*. The lamp connected to circuit *A* flashes up momentarily at the instant when the current begins to flow in circuit *B*, and also when it ceases to flow; but whilst the current flows steadily in the circuit *B*, and illuminates the lamp in series with it, the lamp in series with circuit *A* is not illuminated at all. We have here a lecture experiment illustrating the familiar classical discovery of Faraday of the mutual induction of two electric circuits, viz., that the starting or stopping of an electric current in one circuit induces at the instant of commencement or cessation a brief secondary current in



FIGS. 3 AND 4.

another closed adjacent circuit. I shall not take up time by dwelling on the historical details of this fundamental fact. You know them well. If, instead of starting and stopping a continuously flowing electric current through the circuit *B*, and observing at each "make" or "break" a brief secondary current in circuit *A*, we supply the circuit *B* with an alternating electric current, one of which the direction is rapidly reversed many times in a second, and connect as before a glow lamp in series with circuit *A*, we find that this lamp glows continuously while the alternating current flows in circuit *B*. This also is familiar to us all. If in our first experiment we had employed, as a current detector in the secondary circuit, not an incandescent lamp, but some kind of galvanometer capable of indicating the direction of the induced electric current, we could easily have established for ourselves the fact that at the instant when the continuous electric current begins to flow in the circuit *B*, it generates an oppositely directed induced secondary current in the circuit *A*, which is merely transient current. At the instant when the continuous current is interrupted in circuit *B*, it gives rise to a similarly directed transient induced electric current in the circuit *A*. The momentary currents in *A* are called the *inverse* and *direct* secondary currents, induced by the commencement or cessation of the continuous primary current in circuit *B*. If the primary current is rapidly reversed, as in the case of an alternating current, then the secondary current consists likewise of a rapid succession of currents alternating in direction. In most of our experiments this evening we shall employ an alternating current having a "frequency" of 90 per second—that is to say, changed in direction in the circuit 180 times in a second, and provided

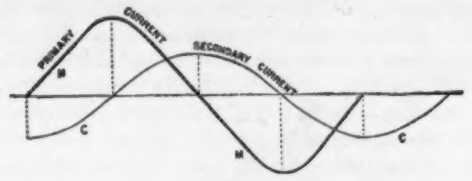


FIG. 5.

for us by the kindness of the London Electric Supply Corporation. If such an alternating current traverses a primary circuit, it induces a secondary alternating current of the same frequency in an adjacent secondary circuit, and this secondary periodic current may be made to induce in another circuit a tertiary current of like frequency, and this, again, a quarternary current, and so on; these successive orders of induced currents being, as it were, the children, grandchildren, and great grandchildren of the primary parent current to which they owe their birth (Fig. 2).

The same large spool of insulated wire will provide us with the means of illustrating another important fact. I join up the two wires *A* and *B* into one length, so as to form one continuous bobbin of wire, and connect this great spiral of wire with a couple of glow lamps, one being in series with the wire spiral and the other being parallel with it (Fig. 3). On sending a steady current through the system it divides between the wire spiral *S* and the lamp L^1, and I adjust the strength of this current so that the lamp L^1 is barely visibly red hot. On interrupting suddenly this electric current the lamp L^1 flashes up for a moment. We recognize that we have here to consider an inertia effect familiar to us as the effect of "self-induction" in the long coil of wire. Audiences in this room have been so carefully informed on many past occasions by brilliant and capable teachers that I may spare you a reiteration of elementary facts concerning the self-induction or inductance of conduct-

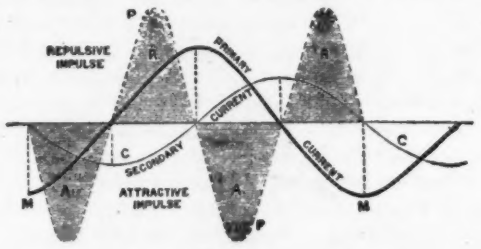


FIG. 6.

ing circuits, and take it for granted that everyone here is intimately acquainted with them, and that you will recall to your recollection that when an electromotive force acts upon any closed electric circuit generating in it an electrical current, this self-induction exhibits itself by delaying or retarding the rise of the current strength to its full or its maximum value; and that, similarly, when the electromotive force is withdrawn, it operates to give the current a persistence, or to retard the rate of reduction of current strength. The convenient term "time-constant" of a circuit is employed to denote that time, expressed in fractions of a second or any other unit, which must elapse before a current rises to a certain definite fraction of its full value, when a steady electromotive force acts upon that circuit. I will next beg you to turn a moment's attention to the electro-dynamic actions or forces which are brought into play when a circuit of any kind is subjected to electro-magnetic induction in a magnetic field. Consider, for instance, a ring of copper hanging in front of the pole of an electro-magnet (fig. 4), having the plane of the ring perpendicular to the lines of magnetic force proceeding out from the pole. Let the magnet be an electro-magnet, and let the pole be suddenly made a north or marked pole. Lines of magnetic force are thrust into the aperture of the ring. This magnetic flux, in accordance with a well-known law, generates an inductive electromotive force which causes a transient current to flow round the ring in a counter clockwise direction, as looked at *from* the north magnetic pole. The ring becomes virtually a *magnetic shell*, having a north pole facing the north pole of the exciting magnet. By the fundamental laws of

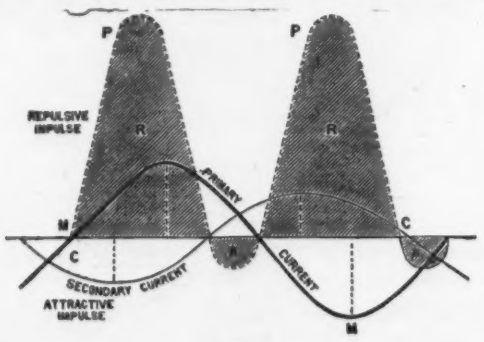
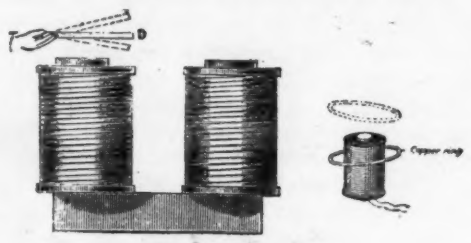


FIG. 7.

action between currents and magnets established by Ampère, the ring experiences a slight repulsive force, due to the electro-dynamic action between the current in the ring and the magnetic pole. The generation of the momentary induced current in the ring is accompanied by an electro-dynamic impulse tending to thrust it away from the pole. Suppose, next, that the electro-magnet is demagnetised. The ring has generated in it a reverse induced current flowing in the same direction as the hands of a clock move when looked at from the magnetic pole. This is also accompanied by an electro-dynamic attraction of the ring towards the pole, but which is much more feeble than the previous repulsion. These attractions and repulsions are well seen when small discs of copper or aluminium are suspended in front of the poles of a powerful electromagnet, which is alternately "made" and "broken." They have been particularly investigated by Mr. C. V. Boys.*

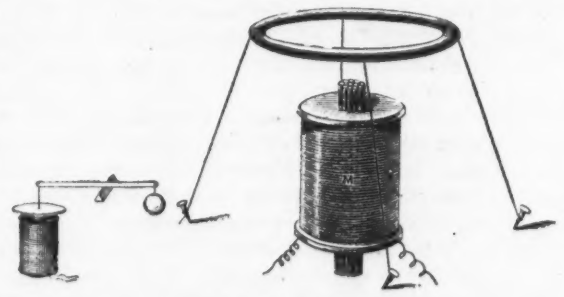
I will now ask you to consider what would happen if the coils of the electro-magnet were traversed by an alternating current? Furthermore, we shall first suppose that the copper ring has a zero time-constant, that is to say, the induced currents in the ring rise up and sink down in strength in exact synchronism with the changes in the inductive electromotive force acting on the ring. If the current flowing in the coils of the electro-magnet is represented as to changes in strength by a simple periodic curve, we may suppose that the magnetism of the core and the magnetic induction through the ring follow a similar law. It is very easy, then, to show that the induced electromotive force acting in the ring circuit, and hence the current in the ring, follows a similar law of fluctuation, but that the instant of maximum current in the ring coincides with the instant of reversal of magnetism in the electro-magnet. Under these circumstances we can represent the changing strength of the magnetic field in which the ring is immersed by a simple periodic curve, *M*, and the changes of current strength in the ring circuit by another simple peri-



FIGS. 8 AND 9.

odic curve, *C*, shifted backwards relatively to the first by a quarter of a wave length (Fig. 5).

By Ampère's law, the force acting on the ring at any instant is proportional to the product of the instantaneous value of the surrounding field and this current strength. If we multiply together the ordinates of these two curves, *M* and *C*, and form a third curve *P*, whose ordinate at every point is proportional to the product of the ordinates of the other curves (Fig. 6) at these points, we obtain a curve which represents the fluctuation of force at every instant acting upon the ring. This curve, *P*, is also a wave-like curve, lying symmetrically above and below the horizontal line. The positive and negative areas of this curve included between the curve and the horizontal line represent the impulses or time integrals of the forces which act upon the ring. These impulses are alternately positive and negative. This is equivalent to saying that under the circumstances assumed the ring gets a series of small pushes and pulls, or repulsions and attractions, which succeed each other at the same rate as the changes of magnetic polarity of the magnet. The series of rapidly alternating and equal impulses would result in leaving the ring apparently unmoved. No real conducting ring can, however, behave in this fashion, because every ring has a sensible "time-constant." Let us see how the above statements will be modified if the ring has such a sensible self-induction that the current induced in the ring lags behind the inducing electromotive force in phase. Repeating the above construction for a force curve, on the assumption that the instant of maximum of the current in the ring occurs later than the instant of reversal of magnetism in the magnet, it is easy to see that the force curve consists now of two very unequal parts. It is not symmetrically situated with respect to the horizontal lines (Fig. 7). The area of the hummocks (shaded portions) which lie above the datum line, and which represent the repulsive impulses on the ring, are much larger than the area of the hummocks below the datum line, and which represent the attractive impulses acting on the ring. This means to say, that the ring when possessing self-induction experiences on the whole a repulsive force, or a series of repulsive impulses, when immersed in such an alternating magnetic field radiated from a magnetic pole; and this repulsive force will be, within certain limits, more pronounced, other things being equal, the greater the time-constant of the circuit. You see clearly, therefore, that a ring or disc of copper in which



FIGS. 10 AND 11.

the induced currents lag behind the inducing electromotive force in phase must experience a repulsive force when this inducing electromotive force is caused by a rapid flux backward and forward of lines of magnetic forces perforating through the ring or disc. The realization of this inference in a striking manner is the first of a series of remarkable experiments on this subject due to Prof. Elihu Thomson. We have on the table an electro-magnet suitable for these experiments, which consists of a core of divided iron, surrounded by a coil in which I can cause to circulate a powerful alternating current of 40 to 50 ampères. Let us, however, begin with an experiment in which we employ a continuous current to energise the core. I give you, in Prof. Elihu Thomson's own words,† an account of this preliminary experiment:

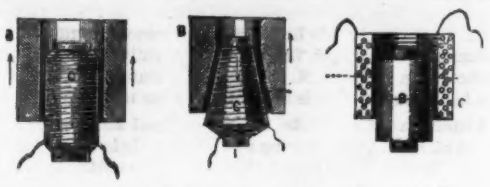
"In 1884, while preparing for the International Electrical Exhibition at Philadelphia, we had occasion to construct a large electro-magnet, the cores of which were about 6 inches in diameter and about 20 inches long. They were made of bundles of iron rod about $\frac{1}{16}$ of an inch in diameter. When complete the magnet was energised by a current from a continuous-current dynamo, and it exhibited

* Paper read before the Society of Arts, May 14, 1890.

*On a "Magneto-Electric Phenomenon." By C. V. Boys, F. R. S., Proc. Phys. Soc., London, Vol. VI., page 218.

†See THE ELECTRICAL WORLD, May, 1887, p. 258:—"Novel Phenomena of Alternating Currents," by Elihu Thomson.

the usual powerful magnetic effects. It was found also that a disc of sheet copper of about $\frac{1}{16}$ of an inch in thickness and 10 inches in diameter, if dropped flat against a pole of the magnet, would settle down softly upon it, being retarded by the development of currents in the disc, due to its movement in a strong magnetic field, and which currents were of opposite directions to those in the coils of the magnet. In fact, it was impossible to strike the magnet pole a sharp blow with the disc, even when the attempt was made by holding one edge of the disc in the hand, and bringing it down forcibly toward the magnet. In attempting to raise the disc quickly off the pole, a similar but opposite action of resistance to movement took place, showing the development of currents in the same direction as those in the coils of the magnet, and which currents, of course, would cause attraction as a result. The experiment could be tried in another way. Holding the sheet of copper by one edge, just over the magnet pole (Fig. 8), the current in the magnet coils was cut off by shunting them. There was felt an attraction of the disc, or a dip toward the pole. The current was then put on by opening the shunting switch, and a repulsive action or lift of the disc was felt. The actions just described are what would be expected in such a case, for when attraction took place currents had

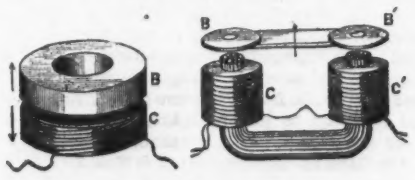


FIGS. 12, 13 AND 14.

been induced in the disc in the same direction as those in the magnet coils beneath it, and when repulsion took place the induced current in the disc was of opposite character or direction to that in the coils. Now let us imagine the current in the magnet coils to be not only cut off, but reversed back and forth. For the reasons just given, we find that the disc is attracted and repelled alternately; for whenever the currents induced in it are of the same direction with those in the inducing or magnet coil, attraction will ensue, and when they are opposite in direction repulsion will be produced. Moreover, the repulsion will be produced when the current in the magnet coil is rising to a maximum in either direction, and attraction will be the result when the current of either direction is falling to zero, since in the former case opposite currents are induced in the disc, in accordance with well-known laws; and in the latter case currents of the same direction will exist in the disc and the magnet coil. The disc might, of course, be replaced by a ring of copper or other good conductor, or by a closed coil of bare or insulated wire, or by a series of discs, rings, or coils superposed, and the results would be the same."

We have already seen that in an alternating field the electro-dynamic impulses so experienced by the disc or ring are alternately attractive and impulsive, and that when the circuit possesses a sensible self-induction, the repulsive impulses overpower the attractive ones, and their repetition constitutes a repulsive force. Before adding a few more words of explanation, permit me to show you some of these electro-dynamic repulsions produced by an alternating electro-magnet. Here is a copper ring, and I lay it upon the top of this electro-magnet, having a divided iron core and excited by a powerful alternating current. On energizing the magnet, the ring jumps up in the air (Fig. 9). If a copper plate is hung like a scale pan from a balanced beam, and placed over the magnetic pole, it gives evidence of being strongly repelled the moment we pass the current through the coils of the magnet (Fig. 10). Instead of employing copper rings or copper plates, we can use closed coils of thick wire, either insulated or not. If, however, our plates or rings have a radial slit made in them, or if our coils of wire are not closed-circuit coils, all the effects vanish.

So strong is this repulsion, with proper appliances, that light copper rings tethered by strings may be held suspended in the air against the force of gravity, the upward electromagnetic repulsion overcoming their weight, and holding them, like Mahomet's fabled coffin, floating in the air (Fig. 11). In cases where we are dealing only with impulsive effects, aluminum rings or discs give most marked results, because aluminum has the highest conductivity per unit of mass; but in the



FIGS. 15 AND 16.

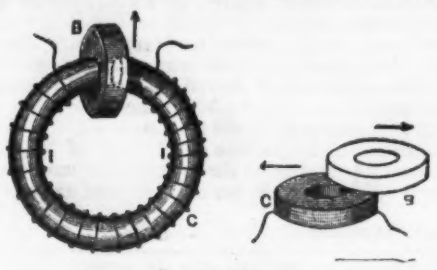
cases like those just considered, where what is required is the greatest force effect, copper or silver gives a better result than aluminum, because they have the highest conductivity per unit of volume. In Mr. Boys' experiments, if I remember rightly, he found aluminum the best to employ. In these cases of electro-dynamic repulsion, the force effect depends essentially upon the lag of the induced current, or its retardation in phase behind that of the inducing field, and, other things being equal, this is proportional to the conductivity of the circuit. I will pass before your view a series of diagrams intended to represent various cases and modes of production of these repulsive effects, giving you descriptions of them in Prof. Elihu Thomson's own words. He says:

"This preponderating repulsive effect may be utilized or may show its presence by producing movement or pressure in a given direction, by producing angular deflection as of a pivoted body, or by producing continuous rotation in a properly organized structure.

"In Fig. 12, *C* is a coil traversed by alternating currents, *B* is a copper case or tube surrounding it, but not exactly over its centre. The copper tube, *B*, is fairly massive, and is the seat of heavy induced currents. There is a preponderance of repulsive action tending to force the two conductors apart in an axial line. The part *B* may be replaced by concentric tubes slid one in the other, or by a pile of flat rings, or by a closed coil of coarse or fine wire, insulated or not. If the coil, *C*, or primary coil, is provided with an iron core, such as a bundle of fine iron wires, the effects are greatly increased in intensity, and the repulsion with a strong primary current may become quite vigorous, many pounds of thrust being producible by apparatus of quite moderate size.

"The forms and relations between the two parts, *C* and and *B*, may be greatly modified, with the general result of a preponderance of repulsive action when the alternating currents circulate.

"Fig. 13 shows the part, *B*, of an internally tapered or coned form, and *C* of an externally coned form, wound on



FIGS. 17 AND 18.

an iron wire bundle, *I*. The action in Fig. 12 may be said to be analogous to that of a plain solenoid with its core, except that repulsion, not attraction is produced; while that of Fig. 13 is more like the action of tapered or conically-wound solenoids and taper cores. Of course, it is unnecessary that both be tapered. The effect of such shaping is simply to modify the range of action and the amount of repulsive effort existing at different parts of the range.

"In Fig. 14 the arrangement is modified so that the coil *C* is outside, and the closed band or circuit *B* inside and around the core *I*. Electro-inductive repulsion is produced as before.

"It will be evident that the repulsive actions will not be mechanically manifested by axial movement or effort, when the electrical middles of the coils or circuits are coincident. In cylindrical coils, in which the current is uniformly distributed through all the parts of the conductor section, what I here term the electrical middle, or the centre of gravity of the ampère-turns of the coils, will be the plane at right angles to its axis at its middle, that of *B* and *C* in Fig. 14 being indicated by a dotted line. To repeat then, when the centres or centre planes of the conductors (Fig. 14) coincide, no indication of electro-inductive repulsion is given, because it is mutually bal-

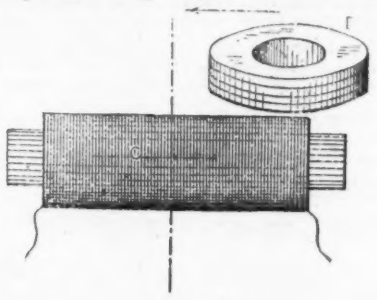


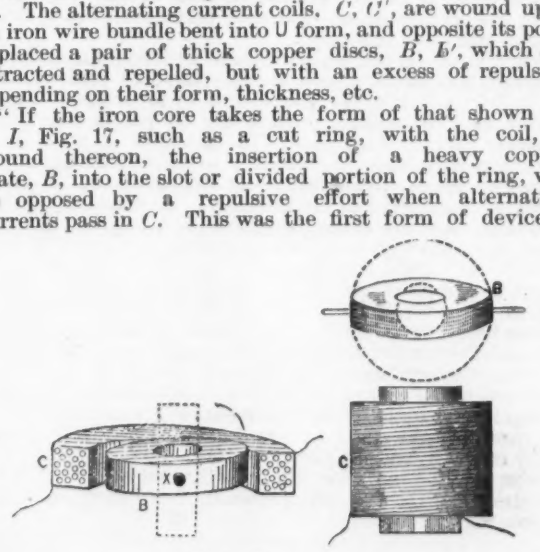
FIG. 19.

anced in all directions; but when the coils are displaced a repulsion is manifested, which reaches a maximum at a position depending on the peculiarities of proportion and distribution of current at any time in the two circuits or conductors.

"In Fig. 15 *B* represents a copper ring and *C* an annular coil placed parallel thereto; and an iron core or wire bundle placed in the common axis of the two coils shows the repulsive action when an alternating current is passed through *C*. *B* may be simply a disc or plate of any form without greatly affecting the nature of the action produced. It may also be composed of a pile of copper washers or a coil of wire, as before indicated.

"An arrangement of parts somewhat analogous to that of a horseshoe electro-magnetic and armature is shown in Fig. 16. The alternating current coils, *C*, *C'*, are wound upon an iron wire bundle bent into U form, and opposite its poles is placed a pair of thick copper discs, *B*, *B'*, which are attracted and repelled, but with an excess of repulsion depending on their form, thickness, etc.

"If the iron core takes the form of that shown by *I*, *I*, Fig. 17, such as a cut ring, with the coil, *C*, wound thereon, the insertion of a heavy copper plate, *B*, into the slot or divided portion of the ring, will be opposed by a repulsive effort when alternating currents pass in *C*. This was the first form of device in



FIGS. 20 AND 21.

which I noticed the phenomenon of repulsive preponderance in question. The tendency is to thrust the plate *B* out of the slot in the ring, excepting only when its centre is coincident with the magnetic axis joining the poles of the ring between which *B* is placed.

"If the axes of the conductors (Fig. 15) are not coincident, but displaced, as in Fig. 18, then, besides a simple repulsion apart, there is a lateral component or tendency, as indicated by the arrows. Akin to this is the experiment illustrated in Fig. 19. Here the closed conductor, *B*, is is placed with its plane at right angles to that of *C*, wound on a wire bundle. The part, *B*, tends to move toward the centre of the coil, *C*, so that its axis will be in the middle plane of *C*, transverse to the core, as indicated by the dotted line. This leads us at once to another class of actions, *i. e.*, deflective actions.

"When one of the conductors, as *B* (Fig. 20), composed of a disc or, better, of a pile of thin copper discs, or of a closed coil of copper wire, is mounted on an axis, *X*, transverse to the axis of coil *C*, through which coil the alternating current passes, a deflection of *B* to the position indicated by dotted lines will take place, unless the plane of *B* is at the start exactly coincident with that of *C*. If slightly inclined at the start, deflection will be caused as stated. It matters not whether the coil *C* incloses the part *B*, or is inclosed by it, or whether the coil *C* be pivoted, and *B* fixed, or both be pivoted. In Fig. 21 the coil *C* surrounds an iron wire core, and *B* is pivoted above it, as shown. It is deflected, as before, to the position indicated in dotted lines.*

"It is important to remark here that, in cases where deflection is to be obtained, as in Figs. 20 and 21, it had best be made of a pile of thin washers or a closed coil of insulated wire, instead of a solid ring. This avoids the lessening of effect which would come from the induction of currents in the ring *B*, in other directions than parallel to its circumference."

Returning for a moment to the theory of these repulsive and deflective actions, it will repay us to consider it in the

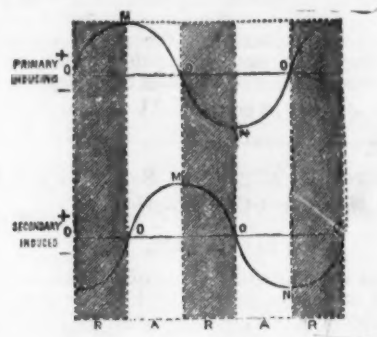


FIG. 22.

form placed before us by Prof. Thomson, in the first paper on the subject, read before the American Institute of Electrical Engineers, May 18, 1887. He says: "It may be stated as certainly true that, were the induced currents in the closed conductor unaffected by any self-induction, the only phenomena exhibited would be alternate equal attractions and repulsions, because currents would be induced in opposite directions to that of the primary current when the latter current was changing from zero to maximum positive or negative current, so producing repulsion; and would be induced in the same direction when changing from maximum positive or negative value to zero, so producing attraction.

"This condition can be illustrated by a diagram. Fig. 22. Here the lines of zero current are the horizontal straight lines. The wavy lines represent the variations of current strength in each conductor, the current in one direction being indicated by that portion of the curve above the zero line, and in the other direction by that portion below it. The vertical dotted lines simply mark off corresponding portions of phase or succession of times.

Here it will be seen that in the positive primary current descending from *M*, its maximum, to the zero line, the secondary current has risen from zero to M^1, its maximum. Attraction will therefore ensue, for the currents are in the same direction in the two conductors. When the primary current increases from zero to its negative maximum, *N*, the positive current in the secondary closed circuit will be decreasing from M^1, its positive maximum, to zero; but, as the currents are in opposite directions, repulsion will occur. These actions of attraction and repulsion will be reproduced continually, there being a repulsion, then an attraction, then a repulsion, and again an attraction, during one complete wave of the primary current. The letters, *R*, *A*, at the foot of the diagram, Fig. 22, indicate this succession. (The shaded portions in the diagrams represent the time during which the force between the primary and secondary circuits is a repulsive force.)

"In reality, however, the effects of self-induction in

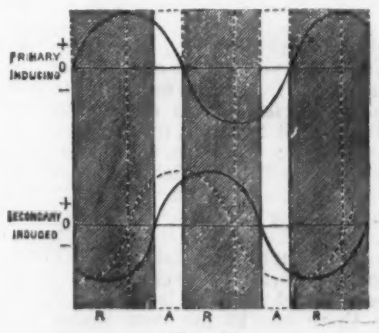


FIG. 23.

causing a lag, shift or retardation of phase in the secondary current, will considerably modify the results, and especially so when the secondary conductor is constructed so as to give to such self-induction a large value. In other words, the maxima of the primary or inducing current will no longer be found coincident with the zero points of the secondary currents. The effect will be the same as if the line representing the wave of the secondary current in Fig. 22 had been shifted forward to a greater or less extent. This is indicated in diagram, Fig. 23. It gives, doubtless, an exaggerated view of the action, though, from the effects of repulsion which I have produced, I should say it is by no means an unrealizable condition.

"It will be noticed that the period during which the currents are opposite, and during which repulsion can take place, is lengthened at the expense of the period during which the currents are in the right direction for attractive action. These differing periods are marked *r*, *a*, etc., or the period during which repulsion exists is from the zero of the primary or inducing current to the succeeding zero of the secondary or induced current, and the period during which attraction exists is from the zero of the induced

*This deflection by an alternating current of a copper disc suspended within a coil with its plane inclined to the plane of the coils, I myself noticed independently, in March, 1887, and subsequently described a copper disc galvanoscope for alternating currents, based on this fact (see the *Electrician*, May 6, 1887). I did not, at the time, know how thoroughly Prof. Thomson had explored the phenomena, but the substantial explanation of it had already occurred to me.

current to the zero of inducing current. (It will be seen that the shaded portions in diagram 23 have been widened out at the expense of the unshaded parts.)

"But far more important still in giving prominence to the repulsive effect than this difference of effective period, is the fact that during the period of repulsion both the inducing and induced currents have their greatest values, while during the period of attraction the currents are of small amounts comparatively. This condition may be otherwise expressed by saying that the period during which repulsion occurs includes all the maxima of current, while the period of attraction includes no maxima. There is then a repulsion due to the summative effects of strong opposite currents for a lengthened period against an attraction due to the summative effects of weak currents of the same direction during a shortened period, the resultant effect being a greatly preponderating repulsion.

It is now not difficult to understand all the actions before described, as obtained with the varied relations of coils, magnetic fields and closed circuits. It will be easily understood, also, that an alternating magnetic field is in all respects the same as an alternating current coil in producing repulsion on the closed conductor, because the repulsions between the two conductors are the result of magnetic repulsions arising from opposing fields produced by the coils when the currents are of opposite directions in them.'

(To be continued.)

The Comparative Cost of Storage Batteries and Horses in Street-Car Traction.

BY PAUL GADOT.

Recapitulation for a line of 20 cars of 50 seats each, using battery tenders and two groups of batteries for running each 50 kilometers per day; annual expenses:

		Francs.
a.	Salaries at station	36,300
b.	Drivers	63,000
c.	Motive power	98,936.90
d.	Interest (batteries)	6,499.80
e.	Repairs to batteries	21,666
f.	Deterioration in plates	97,968
g.	Interest, motors and machinery in cars	3,900
h.	Repairs " " " "	11,250
i.	Abatement, dynamos and machinery in cars	13,000
j.	Tenders	4,968
k.	Oils, waste, dynamos and machinery in cars	20,075
l.	Maintenance and renewal of tools in the depot and on cars	6,000
m.	Interest, deterioration, repairs on dynamos, transmitters, belts, etc	8,400
n.	Various tems	10,000
	Total for traction	401,963.70

The annual number of kilometers traversed by all the cars of such a line being (100 × 20 × 365 =) 730,000, the cost of traction per car per kilometer is 0.551 francs.

Before passing to the hypothesis of three groups of accumulators, we may state approximately the capital necessary for installing battery traction with two daily groups of storage batteries per car.

	Francs.
Engines and boilers, 210 h. p. at 750 francs	157,500
Dynamos for charging transmitters, etc	33,600
Fitting up station, construction, etc	18,000
Storage batteries	108,330
Alteration of cars	65,000
Tenders	24,840
Tools, etc	6,000
A horse	1,200
Extras	24,530
Total	439,000

Or $\frac{439000}{20}$ = 21,950 francs per car in service.

THIRD. *Three groups of accumulators per day, each for 33⅓ kilometers.*

It will not be necessary here to repeat the long details given in the previous cases; we shall merely alter the figures to suit the circumstances, recalling the main lines of our arguments.

Number of cars.—25.

Number of tenders or groups: Three for each car in service = 60. Reserve, 15 per cent. Total, 69.

Weight of batteries: Each group weighs 1,558 kilograms. For each car 1,558 × 3 = 4,674.

For the 20 cars in service, 4,674 × 20 = 93,480 kilo.

Fifteen per cent. in reserve 14,022

Total weight of batteries 107,502

Corresponding to a net weight of plates of 75,279 kilograms, of which 65,460 in service, and 9,819 in reserve.

Charging the Batteries.—From (F) we find that each kilogram of the plates requires, in charging, a force of 11,425 kilogrammeters; therefore, for 65,460 kilograms of plates in service there will be needed per day 11,425 × 65,460 = 747,880,050 kilogrammeters. Say 2,770 h. p. hours, or about 163 h. p. during 17 hours.

These last figures will enable us to ascertain the cost per kilometer of running each car. This cost will include:

a. Salaries in Station, less those charged to motive force. For two groups we had under this head 36,300 francs per annum. Here there are 13 per cent. fewer plates to be cared for, against an increased number of changes of batteries. We shall assume that the two items correspond, leaving the charge 36,300 francs.

b. Car-Drivers.—As in the other case, 63,000 francs.

c. Motive power used in charging: Per day, 2,770 h. p. hours at 0.085 fr. = 235.45 fr. Per annum, 235.45 × 365 = 85,939.25 fr.

d. Interest on storage battery capital: 75,279 kilograms of plates at 1.25 fr., including boxes, etc., represent a capital of 94,098.75 fr., and an annual interest charge of 5,645.95 fr.

e. Repairs to batteries, boxes, etc., change of plates, etc. 75,279 kilograms at 0.25 fr. = 18,819.75 fr.

f. Loss of plates.—The plates alone cost 0.85 franc per kilogram = 65,460 × 0.85 = 55,641 francs. They must be renewed, considering the very hard usage they undergo, say twice a year. There will be thus an expense of

55,641 × 2 = 111,282 francs.

From which must be deducted the price of the old plates, say at 0.20 francs per kilogram ..... 65,460 × 2 × 0.20 = 26,184 "

Leaving an annual expense of ..... 85,098 "

g. Interest on capital; motors, machinery in cars, etc.—For purchasing dynamo and machinery, etc., may be allowed 2,600 francs; or 25 × 2,600 = 65,000; at 6 per cent. = 3,900 francs.

h. Repairs to same.—At 450 francs per car may be estimated at 11,250 francs per annum.

i. Deterioration of same may be taken at 20 per cent., owing to the special conditions under which they are placed. We have then 65,000 francs (see *g*) × 0.20 = 13,000 francs.

j. Here should be added interest deterioration and repairs to tenders.—Each tender costs about 320 francs. There are 69 of them: 320 × 69 = 22,080 francs. Allowing 20 per cent. for all charges, this item comes annually to 4,416 francs.

k. Oil, waste, small details, etc., on dynamos, tenders and cars, may be placed at 2.75 francs per day per car in service.

2.75 × 20 × 365 = 20,075 francs.

l. Maintenance and repairs of tools may be placed at 6,000 francs per annum.

m. Interest, deterioration and repairs of the charging dynamos, transmitters, belts, etc.—Taking the capital at 26,080 francs, and allowing 25 per cent. to cover all, we have an annual charge of 6,520 francs.

n. Various charges, 10,000 francs,

Recapitulation for a line of 20 cars of 50 seats each, using battery tenders and three groups of batteries for running each 33⅓ kilometers per day; annual expenses:

		Francs.
a.	Salaries at station	36,300
b.	Drivers	63,000
c.	Motive power	85,939.25
d.	Interest (batteries)	5,645.95
e.	Repairs to batteries	18,819.75
f.	Deterioration in plates	85,098
g.	Interest, motors and machinery in cars	3,900
h.	Repairs " " "	11,250
i.	Abatement, dynamos and machinery in cars	13,000
j.	Tenders	4,416
k.	Oils, waste, dynamos and machinery in cars	20,075
l.	Maintenance and renewal of tools in the depot and on cars	6,000
m	Interest, deterioration, repairs on dynamos, transmitters, belts, etc	6,520
n.	Various items	10,000
	Total for traction	369,963.95

The annual number of kilometers traversed by all the cars of such a line being (100 × 20 × 365 =) 730,000; the cost of traction per car per kilometer is 0.507 francs.

This is 8 per cent. less than in the case of two groups of batteries and tenders. It is almost identically the same as the figures in the case of three groups in the automobile car; but its great convenience is of importance, cost being the same.

Before passing to the hypothesis of four groups of accumulators, we may state approximately the capital necessary for installing battery traction with three daily groups of storage batteries per car:

	Francs.
Engines and boilers, 163 h. p. at 750 francs	122,250
Dynamos for charging transmitters, etc	26,080
Fitting up station, construction, etc	18,000
Storage batteries	94,098.75
Alteration of cars	65,000
Tenders	22,080
Tools, etc	6,000
A horse	1,200
Extras	22,201.25
Total	377,000

Or $\frac{377,000}{20}$ = 18,850 francs per car in service.

A New Electric Coal Cutter.

The Thomson-Houston Motor Company, of Boston, has put in operation an electric coal-cutting machine which has attracted attention from mining men throughout the country. The machine is in practical operation near Osceola, Pa. The plant consists of a 7 h. p. steam engine, belted direct to a 7 h. p. generator. The electric current is conveyed through the mine to the coal cutter by a wire suspended along the roofs of the chambers. The cutter in this case is nearly a mile from the generating plant. A 5 h. p. motor operates it, and is compactly placed on the same bed plate with the machine. The cutter itself consists of an iron frame 24 inches high, 8 feet 6 inches long and 36 inches wide. Nine auger-shaped drills, similar to those now used in mining, are placed in the lower part of the frame. Between each drill is a steel cutter bar, which cuts all coal left between the holes drilled by the auger bits. On the under side of each cutter bar are attached several scrapers, which hang loosely and pull all the coal back as fast as it is cut or drilled, keeping it out of the way and making the opening clear. All coal taken out of this cut is coarse, and none is wasted.

The height of the cut is four inches. The machine makes two cuts in five minutes, as it is easily handled and needs only to be pushed along the breast by lever bars. The switches and controlling devices are so placed that one man easily operates the cutter. The machine is provided with a twin wire cable long enough to extend along any ordinary chamber, thus doing away with the need of permanent wiring except in the headings. A suitable truck is provided for the cutter, upon which it may be carried around the mine with case. An ingenious device will be provided on future machines, by means of which the motor will pull itself and the cutter off and on the track, as required. The weight of the complete machine is a little over one half a ton. One strong point in favor of this machine is the readiness with which it accommodates itself to the varying hardness of strata.

The motors are wound for but 220 volts pressure, so that all danger from high potential currents is done away with. The capacity of the machine is said to be 180 tons of coal per day of ten hours in a four-foot vein. Several improvements on the first machine will be embodied in the regular apparatus which is now being manufactured at the Thomson-Houston Motor Company factories, in Lynn.

Atmospheric Electricity.

In the course of four years of experimenting, M. Albert Nodon has established the fact that when the sun's rays fall upon an insulated conductor, metal or carbon, they communicate thereto a positive electric charge, which increases with the intensity of radiations and decreases with the hygrometric state of the air. At Paris the electrification is greatest at about 1 P. M., when the air is clear and dry; but it disappears on the passage of clouds near the sun. The experiments indicate the source, or, at least, one source, of atmospheric electricity, as it may be assumed that the surface of the earth becomes positively electrified, while the heated air rises with a negative charge, which it imparts to the clouds. This hypothesis would explain many thunder-storm phenomena, including the frequency of such storms over forests, rivers, lakes, etc., where the cooler air causes the electrified clouds to fall toward the earth until a discharge takes place.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK. June 7, 1890.

Mr. D. H. Shay, of the Charles Munson Belting Co., of Chicago, is in town this week.

Mr. Geo. M. Wheeler, of the Holmes Electric Protection Company of Montreal, is in town.

Mr. George W. La Rue, 239 Broadway, is still ready for business with the Sprague Motor. In this case ready does not mean waiting, for Mr. La Rue's hands are busy and his facilities at full test supplying the many orders that flow in upon him.

The North American Construction Company, of which Mr. Charles D. Doubleday is manager in this city, have taken over $500,000 in new business this spring, $40,000 of which was secured in Mr. Doubleday's district. All of the Westinghouse construction work in the United States is done by this company, and every agent is fully established in his own territory and thoroughly equipped for the acceptance and completion of large orders.

Mr. R. H. Sherwood, the New York representative of the railroad department of the Thomson-Houston Company, has opened the company's offices at 115 Broadway, where he is ready to receive orders for anything in his line. Mr. Sherwood, it will be remembered, closed the contract for the electric railway now in course of construction in Newark, N. J. He has a number of other contracts on hand, but says he is always ready for more.

The American Institute of Electrical Engineers were reported in our last issue to have established their headquarters at No. 12 West Twenty-third street, this city. The notice should have read 12 West Thirty-first street. In making this correction an opportunity is afforded for congratulating them upon their acquisition of such pleasant quarters, and for wishing them as prosperous and pleasant a time in the new home as they have enjoyed in the old.

P & B. Armature Varnish is meeting with great favor, particularly among electric railways and other applications where every protection to armatures is most needed. It thoroughly prevents dampness or moisture from penetrating the armature cores, and you can wash your motors with a hose, if necessary, after applying this varnish. The Standard Paint Company, 59 Maiden Lane, will be pleased to furnish testimonials as to the efficacy of this varnish.

The Charles M. Smith Manufacturing Company, of 82 John street, make a specialty of supplying the electrical trade with all kinds of cabinet work. They make annunciator and burglar-alarm cases, telephone transmitters and battery boxes, as well as cases for medical batteries and bases for all kinds of electrical instruments, push buttons, shells, etc. They are doing a large trade in this business, which is feeling the impetus given by the expansion of the electrical field, and supply their customers at the lowest prices.

Storage Batteries for Medical and Surgical Work are finding place as the field of medicine and surgery is opening to electricity. In all the varieties known to the trade, and in any special pattern desired by a practitioner, these storage batteries are supplied by the Waite & Bartlett Manufacturing Company, No. 143 East Twenty-third street, this city. But this is by no means the only trade done by the company. They are manufacturing electricians, and turn out electric motors and other electric specialties. Their offices are conveniently located, and they are always prepared to show samples of the wares in which they deal, or they will send a catalogue upon application.

The National Electric Company, successors to the electrical department of the New Haven Clock Company, have procured a new factory at Milford, Conn., which faces on the New Haven Railroad, and is about 40×280 feet. The National Company moved into their new factory on June 1, and are placing in it all the machinery which they acquired from the Clock Company. They have purchased also a large lot of new and improved machinery, and when entirely settled will be well able to turn out their manufactures in large quantities. The New York offices are at 14 and 16 Vesey street.

Mr. T. W. Ness, the Montreal dealer in electrical supplies, bells, batteries, annunciators, telephones, motors, etc., who was burned out a short time ago, is in town. This is a business visit, and Mr. Ness is accompanied and assisted by Mr. Wm. B. Shaw, the expert who attends to the electrical part of Mr. Ness' business in Montreal. These gentlemen are making heavy purchases in the city, as Mr. Ness declares his intentions of restocking with a larger and more complete assortment of his goods than he had when burned out. There is no doubt that they can find all they want, and that the trip will be thoroughly satisfactory to them and others.

Photographing Machinery and appliances pertaining thereto is as useful in the electrical trade as in any other where large machinery is used. It is interesting to note how rapidly the electrical business has grown, and as small matters sometimes are the indicators of large affairs, the fact that some photographers can afford to give special attention to photographing electrical apparatus is an indication of the growth and importance of the production and sale of the latter. Messrs. George P. Hall & Son, 303 Broadway, are devoting much time to this branch of their work, and will respond as quickly as possible to an order given through their telephone, No. 3,844 Courtlandt, bringing with them their necessary paraphernalia for securing a good photograph of whatever object is to be taken.

The United Edison Manufacturing Company has just issued a very artistic catalogue giving detailed information concerning the Edison systems. It explains the various apparatus by the aid of excellent descriptive cuts, and furnishes a vast amount of interesting information. Perhaps the most valuable part of the little book is that which gives letters from Edison stations in every part of the country, telling the results of varying experiences with the system. In these reports three things are specially noticeable—the very small amount of trouble given by the apparatus; the steady increase in business; and the long life of the lamps. Most of the stations show an average lamp life far in excess of that guaranteed, and in very few cases does the figure fall below 1,000 lamp hours.

Electric Gas Fixtures.—The demand for these goods is increasing daily, and the Brooklyn Gas Fixture Company, of which W. C. Vosburg is president, have in consequence of their growing business, enlarged their manufacturing facilities, and made extensive additions to their salesrooms. A full line of staple fixtures are always carried by this company, and they make a specialty of designs that are neat and attractive. Their reputation in this direction is hardly to be excelled. They have lately spent a large amount of money in purchasing automatic and improved machines for making electrical fixtures, and with these facilities feel competent to turn out large orders at short notice. Any one who would like to examine a fine line of goods of this kind will be cordially received at 722-728 Atlantic Avenue, Brooklyn.

Mr. A. B. Laurence, representative of the Shultz Leather Belting Company, 225 Pearl street, this city, has issued a partial list of the names of those to whom he has sold belting since July 1, 1889. Among the many names recorded as purchasing dynamo belting the following appear: Laboratory of Thomas A. Edison, Orange, N. J; Edison Electric Illuminating Company, 432 Fifth avenue, New York; East River Electric Light Company, East 24th street, New York; Edison Electric Illuminating Company, Paterson, N. J., Patterson Electric Light Company, Paterson, N. J., and Metropolitan Telephone and Telegraph Company, 18 Cortlandt street, New York. Mr. Laurence is an old established belt merchant, and knows thoroughly the requirements which belting should meet, as well as the merits of the belt he is now handling. Mr. Laurence is also making a specialty of the leather pulley covering made by the Shultz company.

Kerite Wire.—For nearly 20 years this wire has enjoyed a reputation that is enviable and that as yet shows no sign of diminution; indeed, Kerite is rather increasing in common repute, because of the maintenance of its high standard. Many miles of this wire are used in the conduits of New York, Chicago, Boston, Philadelphia and other large cities, and I have yet to hear of a single report of its inefficiency. Its life is long, as was proven by the condition of the wire taken from the poles in this city last year by the action of the Subway Commission. Some that was then cut down had been in use for 10 years and was still good for as many more. If Kerite wire needed any attestation of its merits other than that afforded by the many testimonials from its users, surely such a need would be met by the action of Mr. George B. Prescott, Jr., in becoming the general agent for its sale and his establishment here in New York, where he is so well known as an electrician and as an expert on the necessary qualifications of insulating wire. Mr. Prescott's office is at 14 Dey street, where he is always glad to see his friends and receive their orders. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
No. 146 Franklin, corner Congress St.
BOSTON, June 7, 1890.

Oldtown, Me., will soon have electric lights.

Salem, Mass.—The Essex Electric Railway Company has purchased the Derby Wharf property on private terms, and will erect a power station there.

H. C. Spaulding, of the Thomson-Houston Motor Company, has been elected Treasurer and Secretary of the New England Electrical Exchange, vice H. H. Fairbanks, resigned.

Bridgeport, Conn.—The Bridgeport Silk Mill Company are to do away with their steam engines and use electric motors in their stead.

Bird & Sloane have established an office at 44 Sudbury street, Boston, and are prepared to do wiring of all kinds. Mr. Bird was formerly with the Edison Electric Company, and Mr. Sloane is the inventor of the Ward & Sloane battery.

Mr. Norman W. Crawford has resigned from the superintendency of the Daft Company, of Meriden, Conn., and accepted a position with the Short Electric Railway that will cover a large field. His headquarters will be at Rochester, N. Y.

Greenwich, Conn.—The new plant of the Greenwich Gas and Electric Light Company was started for the first time last week, and gives much satisfaction both to Superintendent Owens and to the villagers. The system used is that of the Thomson-Houston.

Mr. H. C. Spaulding, of the Thomson-Houston Electric Company, has been elected treasurer and secretary of the N. E Electric Exchange, vice H. H. Fairbanks, of Worcester, resigned. Mr. Fairbanks takes the seat at the board vacated by Mr. Spaulding.

The Inter-Continental Telephone Company has received through Kidder, Peabody & Co., £25,000 from the English syndicate, and will now distribute the money amongst its shareholders, of whom the Tropical American Telephone Company is the largest owner.

Mr. C. W. Holtzer, of the Holtzer-Cabot Company, was thrown from his carriage by being run into by a carelessly driven team while out driving on Sunday, June 1, with Mrs. Holtzer, and was badly injured in his thigh. Latest reports are favorable, however, and he will probably be out in a few days.

Brockton, Mass.—The electric plant at this place supplies about 150 motors scattered throughout the shoe factories, stores and shops. It also supplies current for the electric railway, besides 110 arc lights and 500 incandescents. The equipment is a 150 h. p. dynamo for the motors, three arc-light machines and two incandescent dynamos.

Lowell, Mass.—By the breaking of a counter-shaft at the works of the Lowell Electric Light Company recently, about two tons of metal was precipitated among the dynamos, making a serious wreck. The damage amounts to quite a large sum of money. Temporary repairs were made and the service was resumed after a short delay.

The Franklin Telegraph Company held their annual meeting on Wednesday, June 4, at 109 State street, Boston. Mr. Thomas Roche presided. The following gentlemen were elected directors for the ensuing year: John Van Horne, Norvin Green, Thomas Roche, A. R. Brewer, Joseph F. Greenough, Chas. A. Tinker, Thomas J. Eckert, Frederick L. Ames and J. Gould. R. H. Rochester was elected treasurer and Thomas Roche clerk.

J. A. Grant & Co., of Boston, have been awarded the contract for the entire steam plant, aggregating 300 h. p. in connection with the large contract which the Thomson-Houston Company have received from Kingston, Jamaica. They have also set up, and have running in the new buildings of the Shoe & Leather Association, Boston, a 125 h. p. MacIntosh & Seymour engine in connection with the Evans friction devices.

Salem, Mass.—At a meeting of the Salem Aldermen, held on June 1, a hearing was given on the petition of the Essex street Railway Company for permission to maintain an overhead trolley system. There was no opposition. Hearings were ordered for June 18 on the petition of the Lynn & Salem Company, *et al.*, for street railway location through Ward 3, and on that of the Naumkeag Street Railway for a location on Loring avenue.

Debenture Bonds.—The note in our last concerning a debenture bond company, formed to purchase Thomson-Houston bonds, told only part of the story. The title of the company is the United States Electric Securities Company, and its purpose is to assume the bonds of Thomson-Houston light and power plants, issuing debenture bonds to cover them. Its dealings will be only with local companies, and it forms no part of the central Thomson-Houston Company.

The Pierce Brothers Trolley Holder Company have organized, and will manufacture at Leominster, Mass., the device of Homer Irving Pierce, of Lynn, for suspending electric conductors. The invention consists of a device by means of which the conducting wire is suspended in a safe and efficient manner, and which shall afford a continuous smooth track over which the trolley may pass without danger of jumping the wire or sparking. They have already received a large order from the Lynn and Boston road.

Meriden, Conn.—The Anglo American Electric Light Company, whose storage battery plant is now located in the old Peck, Stow & Wilcox factory at Kensington, are seriously considering the removal of their plant to this city. A number of leading business men, among whom are Robert Bowman, Samuel Dodd, A. Chamberlain, C. L. Rockwell and Walter Hubbard, compose the committee interesting themselves in the matter. If the plant is removed here plenty of money will be forthcoming, and the push and energy which has built up a large and successful business for each of the above gentlemen will soon bring the Anglo Company to the front rank.

Newton, Mass.—Petitions were before the Board of Aldermen last evening from the Gordon City Electric Street Railway Company for a location of route and a permit to operate storage battery cars. A hearing was ordered for June 18, at 8 P. M.—The Newton Central Street Railway Company applied for location and a permit to operate its route by the overhead system. A hearing was not assigned.—The Newton Street Railway Company was granted an extension of one month's time, dating from June 1, to complete the building and equipment on a franchise already granted, between Newton and West Newton, extending to the Waltham Line.

Brookline, Mass.—The selectmen gave a hearing in the town hall last night on the petition of the West End Street Railway Company for a proposed car house on Chestnut Hill avenue. Mr. Hyde appeared for the railway company, and gave urgent reasons why the petition should be granted. Mr. Goodwin and Mr. Eugene Knapp spoke in favor of the company's petition, and thought that all reasonable requests should be granted. Mr. Alfred D. Chandler appeared as counsel for a number of property owners in the vicinity of the proposed site for the car house, and strenuously objected to the petition. Doctor Sinclair and Mr. J. Willard Pierce also appeared as remonstrants. The selectmen took the matter under advisement.

Beverly, Mass.—The annual meeting of the Beverly and Danvers Storage Battery Railway Company was held in the power station, Tuesday, June 3. The old board of officers was re-elected, with the exception of Austin Whitcomb, treasurer. Peter E. Clark was elected in place of Mr. Whitcomb. Hon. John I. Baker, Peter E Clark and Gilbert Tapley, of Danvers, were appointed a committee to consider the advisability of leasing the road. It was voted to petition the Selectmen of Danvers and Beverly, the former board, for authority to extend the tracks to Danvers Plains, and the latter for authority to lay tracks through Stone, Lathrop and Washington streets; also to petition the Railroad Commissioners for authority to use the Naumkeag tracks to Stone street, and from Washington street to Elliott. The meeting adjourned to June 10.

Mr. Eugene F. Phillips, of the American Electrical Works, Providence, R. I., gave an "old fashioned clam bake" on Wednesday last at the Ponham Club, Providence River, to Mr. and Mrs. John I. Sabin, of California. The party departed from Providence about 11 A. M., via the private steam yacht, "Riverside." The feast was one of the "old timers," and, it is said, Mr. Phillips even outdid his famous fourth of July "bake." Foot-ball, boating, etc., were indulged in, and the party returned about 5 P. M., voting Mr. Phillips the prince of entertainers. Among the invited guests were the following well known people: Mr. and Mrs. John I. Sabin, Miss Grace Sabin, Mrs. E. F. Phillips, Mr. E. R. Phillips, Mr. F. N. Phillips, Mr. and Mrs. W. A. Sawyer, Mr. and Mrs. F. E. Pettingill, P. C. Ackerman, C. Wagenseil, Col. and Mrs. Keeler, Mr. and Mrs. E. B. Baker, Mayor Henry R. Barker, Mr. Henry Barker, Miss Jessie Barker, Mrs. Hoxsie, Miss Lincoln, Mr. A. C. Wight, Mr. E. A. Smith, Mr. Thos. Doolittle.

The National Electric Construction Company have opened offices at 620 Atlantic avenue, this city, and will commence active operations in a few days. The capital stock of this company is $2,000,000, divided into 40,000 shares at a par value of $50. The company is formed for the purpose of constructing plants for the generation of electricity for all useful purposes; for the construction and equipment of electric street railroads; for the control of water privileges; for the manufacture and sale of illuminating and fuel gas, and for the manufacture of gas and electrical apparatus and machinery. They begin business with many very valuable franchises for light, power and water privileges, every franchise carrying with it contracts for street lighting. In addition to these, many orders for the construction and equipment of street railroads have been received. Hon. Benj. F. Butler is president of the company; Andrew Washburn, vice-president, and Hon. Linus M. Child, treasurer. A number of well-known business men compose the board of directors. L. H. H.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING. PHILADELPHIA, June 7, 1890.

The Eureka Tempered Copper Company's products—factory at North East, Pa.—are constantly increasing in popularity, and their well known metal is giving perfect satisfaction wherever metal is used in electrical work. They received 114 orders for their specialties during the month of May.

The Camden Thread Company, located at Hancock and Berk streets, this city, are doing a good business in glazed threads of all colors and sizes, and colored yarns in skeins, on spools or tubes. These yarns are especially adapted for insulation for electric wires, and Mr. Robert G. McLaughlin, who is connected with the company, says that they are supplying all the principal wire companies in Pennsylvania. Mr. S. Russell is the company's representative on the road.

Messrs. Barr & Kern, 612 Arch street, have obtained control of the patents of the Partz Electric Battery Company, formerly located at 636 Arch street. Barr & Kern have met with gratifying results in the sale of the Partz battery, which they have in use in many of the large establishments in this and other cities. They have also closed a contract to furnish the public departments of this city with the Partz acid gravity battery, and sulpho-chromatic salt. A full line of electric supplies is always on hand, and the firm will be glad to correspond with those who need anything in their business.

The Grove Electric Company, 1406 Chestnut street, have applied for patents for a new electric fire-alarm attachment that will be used in connection with annunciators, and that is designed especially for use in hotels, as it will give instant alarm to all parts of the building. A small thermostatic thermometer is attached to the wires of the annunciator, just adjoining the push button in each room, the terminals of the thermometer being connected with the the terminals of the push button. When the temperature of the the room in which the alarm attachment is located reaches 102 degrees, the thermostat closes the current and operates the annunciator. Mr. Grove is certain that his attachment will prove a success, and expects soon to have a large number of orders.

The Brill Truck Company.—When the equipping of already existing roads with electric motors was begun, the J. G. Brill Company realized the importance of having a separate and independent vehicle to hold the motors and carry the car, that would overcome the faulty construction first adopted. This company then designed and obtained patents on the separate trucks, whereby the motors were carried on supports, and cog-wheels could be used in place of the primitive apparatus of sprocket wheels and chains. The large sales of the Brill trucks, now so widely known, have compelled the company to move to larger and more commodious quarters, where they will have better facilities for meeting the demand made upon their manufacturing department. They are already at work in their new plant on the corner of 62d and Woodland streets, where they are located between the Baltimore & Ohio and Pennsylvania railroads, and where they will move their office this week or next.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, June 7, 1890.

Mr. J. F. Holme, of the Pittsburgh *Press*, has become a member of the National Engineering Bureau of Chicago.

Colonel J. H. Shay, of the Charles Munson Belting Company, Chicago, has secured an order from the Missouri Electric street Railway Company, St. Louis, for 266 feet of 54 inch and 300 feet of 16 inch Munson's leather belting.

Mr. F. A. Armour, the Chicago agent of the Detroit Motor Company, has secured the contract for supplying to the Columbia Theatre eight Detroit motors, of which one gives 10 h. p., two 5 h. p., one 2 h. p. and 4 are fan motors.

The Garden City Electric Lighting and Power Company, has been incorporated at Chicago, to furnish light, heat, and power. The capital stock is $25,000, and the incorporators are: C. A. Buell, D. V. Bussie, and H. W. Wells.

Mr. C. G. Armstrong, late with the Monitor Electric Company, has been engaged by the Great Northwestern Electric Supply Company, of Chicago, to take charge of the house goods department of their district messenger supplies.

Julius Andrae, of Milwaukee, Wis., has recently supplied several complete Eddy outfits for copper-plating establishments. They have also sold several small incandescent dynamos, and have taken the contracts for wiring a number of new buildings.

The Markle Engineering Company, 133 Jefferson avenue, Detroit, have met with excellent success during the past two years in the sale of their Electroleum, a special dynamo oil, for which they have established a permanent trade extending from Texas to Michigan.

The Markle Engineering Company, 133 Jefferson street, Detroit, Mich., are placing two compound non-conducting Beck engines in the Edison sub-station in Detroit, under a written guarantee that not more than 2¼ pounds of coal nor more than 26 pounds of water per horse-power hour shall be required.

The Knapp Electrical Works, 54 and 56 Franklin street, Chicago, are loading their shelves with duplex conductor cord for incandescent circuits, manufactured by the American Electrical Works. This company is also carrying a nice line of low priced fan motors especially designed for office use during the hot summer months.

The Spokane Falls, Wash., Electrical Society held their regular monthly meeting on the evening of June 3, in the rooms of the society. Mr. Charles B. Hopkins presided over the meeting, and Mr. John Mackenzie, of the Edison Electric Illuminating Company, the secretary of the society, delivered the lecture of the evening, on "Magnetism and the Electro-Magnetic Theory of Light."

The Illinois Electric Material Company, 341 The Rookery, Chicago, are doing an unusually good business in the line of poles for electric light and railway circuits. Since they completed arrangements for carrying several hundred car loads of live cedar poles constantly in stock, they have been kept busy filling orders from contractors who appreciate an arrangement that enables them to have their orders filled promptly.

Second-Hand Dynamos.—Anyone desiring a dynamo for charging a small storage battery, for plating or for experimental work, may save time and money by looking over the list of machines offered for sale by the Rose Electric Light Supply Company, St. Louis, or in corresponding with the company. While in Chicago last week, Mr. Rose purchased a sufficient number of dynamos to fill an entire car, the majority being small and in excellent condition, having been taken in exchange for larger machines.

The Electrical Supply Company, 171 Randolph street, Chicago, the pioneers in the supply line, are crowded with business. In a recent chat Mr. Wm. Taylor, Mr. Terry's chief of staff, said: "The more competition we have had the greater our sales have become; until now we hardly know where matters are going to end. Mr. Terry is now in the East, arranging to carry even an greater supply than we now have, although every foot of available space is occupied, and several outside store rooms are filled." Everyone entering the store is at once impressed with the air of prosperity and push that surrounds the house.

The Great Western Supply Company, 190 and 192 Fifth avenue, Chicago, are gradually getting into shape to do a very heavy business, and by June 15 they will be able to handle orders of any size. At the present time carpenters, plumbers, furniture men and others are in possession of the entire building, and little else is being done than to store away the car load lots of wires, supplies, etc., that are rolling in. Mr. Cutter is also surrounding himself with a staff of competent assistants, all of whom will be well up in their respective departments, and thus able to give prompt and careful attention to every order coming in to the house.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$295@$300	Cumberland	$ 59@ $60
Central Union	70@ 71	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

F. DE L.

SOUTHERN NOTES.

Norfolk, Va., June 7, 1890.

Dayton, Tenn.—An electric light plant is contemplated.

Vosburg, Miss.—An electric light plant is to be established here.

Beattyville, Ky.—An electric light company is being organized.

Albany, Ga.—It is stated that an electric street railway is soon to be built in this place.

Gadsden, Ala.—An electric street railway will be put in operation by Hughes & O'Connell.

Gadsden, Ala.—An electric light plant will be established by Messrs. Banks, Arnold & Co.

Augusta, Ky.—A charter has been asked for the Augusta Electric Light and Gas Company.

Riverton, Ala.—The North Alabama Development Company is preparing to establish an electric light plant.

Austin, Tex.—The Austin Street Railway is doubling its track, and will use electricity as a motive power.

Elizabeth City, N. C.—The Elizabeth City Electric Light and Power Company will shortly begin the manufacture of ice.

Houston, Tex.—The City Council is contemplating the establishment of an electric fire-alarm system. Estimates are desired.

The Anniston, Ala., Gas and Light Company have secured a contract to extend their wires to Oxford and light that town.

Ronceverte, W. Va.—An incandescent electric light plant will be erected and operated by the Greenbrier Dressed Beef Company.

Carrollton, Ky.—The Kentucky legislature has been petitioned for a charter for the Carrollton Electic Light and Power Company,

Anderson, S. C.—J. E. Roddy and W. C. Witner have organized the Anderson Electric Light and Power Company with $10,000 capital stock.

Baltimore, Md.—The subscription books to the capital stock of the Hampden and Waverly Electric Light and Power Company were opened in Baltimore on May 29, and the stock is being taken rapidly.

Cartersville, Ga.—The Georgia and Tennessee Construction Company, lately incorporated by A. M. Smith and G. A. Aubrey, with a capital stock of $50,000, propose building and operating an electric light plant.

Richmond, Ky.—The gas and water works and electric light plant have been purchased by W. E. Boardman, of Macon, Ga., and Woodbury & Moulton, of Portland, Me. The property is to be improved and enlarged,

Augusta, Ga.—The Augusta and Summerville Railway ran its first electric car one day last week, and now a regular schedule is in force. Mr. Crowley, of Atlanta, and Mr. Vining, of Macon, prominent Thompson-Houston electricians, established this plant.

Hot Springs, Ark.—The Electro-Chemical Amalgamating Company, with $500,000 capital stock, has been incorporated to build and operate electro-chemical amalgamating and smelting works. Mr. C. P. Gaboury, of Centreville, R. I., is the president of this new company.

The Augusta, Ga., Electric Railway Company, which was chartered by the Kansas City syndicate, has built a double track about six miles in length. This is only a limited portion of their line, but is the part they will have in operation in time for the State military encampment.

Baltimore, Md.—The Union Passenger Railway Company has applied to the Board of Aldermen for privilege to use electricity with over-head wires. Their prayer was confronted by a counter petition from property holders on the line of the railway, urging that "the system of electrical conductors proposed is highly objectionable." The matter was referred to the Committee on City Passenger Railways.

New Orleans, La.—The City Council has passed an ordinance requiring all naked wires in use for electric purposes to be replaced by insulated wires within the next year. The same ordinance places the electric light companies of the city under the orders of the chief of the fire department, who is empowered to cut any wires that may be in the way of the effective working of the fire department. Each electric company is permitted to have an inspector at every fire to point out what wires should be cut.

Atlanta, Ga.—The newly created Board of Elec rical Control recently held its first meeting in this city. Alderman J. G. Woodward, as chairman of the Light Committee, became ex-officio chairman; Chief of the Fire Department W. R. Joyn, was made secretary; City Engineer R. M. Clayton is the other member of the board. Mr. W. B. Walker was elected superintendent of electrical affairs, and will take charge of all matters pertaining to electric wire and other apparatus that come within the jurisdiction of the city.

The Baxter Electric Motor Company, Baltimore, Md., hope in the near future to be in direct railway communication with all parts of the country. This will be effected by building a branch track from the line of the Philadelphia, Wilmington & Baltimore Railroad, near the factory, directly into the works; a plan that was projected when the shops were built, but which has been delayed on account of the contemplated elevation of the railroad tracks through the city. This will be done this summer, and then a spur line will be run into the Baxter Motor Works, thus enabling the company to ship goods directly from their shops to any point, and obviating the inconvenience of transferring heavy machinery by trucks to the station.

Richmond, Va.—The recently consolidated railway company appears to be having some unpleasntness among its officials. About a week ago Mr. W. B. Watson, cashier of the company, handed in his resignation. And now it is announced that Mr. Charles T. Dabney, general manager of the railway, has also resigned. It is understood that Mr. Dabney withdrew because the company did not place at his disposal the facilities which he had been led to believe would be given him for properly equipping and operating the road, and that, while he was nominally general manager, his power and authority were much more circumscribed than he anticipated from his agreement. The position made vacant by Mr. Watson has been filled by the appointment of Mr. W. M Winston, who has been superintendent of the Marshall street line since it first opened. Mr. Dabney has been succeeded by Mr. J. B. Wilbur, now a resident of Richmond, who is said to have spent his life in railroad work. Both gentlemen have entered upon the discharge of their respective duties. Mr. Fisher, of New York, who practically directs every movement in connection with the different properties, stated recently that six cars were being equipped with heavy motors.

Y. N. B.

THE TELEGRAPH.

Houston, Tex.—A bid will be introduced in the city council to provide the city with an electric fire-alarm system. The mayor can give information.

The Telegraph in Chili.—Chili is going ahead in the matter of telegraphy. Telegraph lines are to be laid from Arauco to Carampangue, from Constitucion to Patù, from San Fernando to Chimbaronga, from Palmilla to Alcones and Pichilemu, and from Anjeles to Antuco. These lines will bring five small seats of population into telegraphic communication with the rest of the Republic, and thus confer a great boon on the inhabitants.

The Telegraph as a Factor in Government.—Lord Salisbury has recently expressed his indebtedness to the work of the telegraph in governing England. It is in the fact that all the chancelleries in Europe are now practically conducted by the service of the electric telegraph that its greatest service to the world is expressed. It is one thing to carry news by telegraph, and it is a much higher thing for the premier of England to sit in his office and by the touch of his hand be put in immediate communication with the leaders who are controlling each separate section of the civilized world. Nothing so much expresses the accelerated movement of things to-day as the fact that the prime minister of a country can transact in one hour the business which was formerly stretched out over days, or even months of time before it could be completed.

Scott's Flashing Signal Lamp.—This has been specially designed to enable signals to be flashed according to the Morse code at a speed far greater than any method yet proposed, and from any distant point, such as a masthead, etc. A number of shutters are actuated simultaneously by a wheel attached to the armature of a magnet, which is energized at intervals corresponding to long and short flashes. By a special arrangement of circuits the incandescent lamp in the lantern is run at a comparatively low temperature while the shutters are closed, and brightens up only for the period of the flash. A special key, similar to a telegraph key, is used in sending the signals, and a Morse recorder is attached, so that signals are permanently recorded for subsequent reference. A lantern of this type has been working with much success on board one of the British war ships for the last nine months. The lamp is in the Woodhouse & Rawson's United, Limited, exhibit at the Edinburgh Exposition.

THE TELEPHONE.

Atlanta, Ga.—The Southern Bell Telegraph and Telephone Company is said to have purchased a site for the erection of an office building.

Scotland.—Edinburgh, Glasgow and Dundee are now in telephonic communication by a new trunk line 100 miles long, which is conveyed under the Tay by a cable two and a half miles long.

A Long Telephone Cable.—If Spain is connected with Porto Rica and Cuba by telephone, a scheme now under consideration by the Spanish government, there will be laid the longest telephone cable in the world.

The Louisville, Ky., Telephone Exchange is adopting on all its lines, a new lightning and high tension current arrester, the invention of Mr. Maxwell, the superintendent of the Ohio Valley Telephone Company. The arrester has many novel features, and is said to be better than any of the other forms at present in use

Milwaukee, Wis.—On May 30 a telephone wire fell upon the highly charged trolley wire of the Hinsey Electric Street Railway. While there was no observable effect at the point of contact, the telephone wire conducted the current from the trolley wire to the switchboard at the central office, entirely destroying the board, with its accompanying wires. The city service was in consequence seriously affected for about 24 hours.

THE ELECTRIC LIGHT.

Telluride, Colo., is to have electric lights.

Lebanon, Mo., has voted to erect an electric light plant.

Shelton, Wash.—An electric light plant is to be put in at this place.

Algona, Ia., expects to indulge in the luxury of electric lights.

Montgomery, Ala.—D. P. West will, it is reported, erect an Edison electric light plant.

Wallace, Idaho.—An electric lighting plant of 650 lights is to be established at this place.

Markham, Ont.—This village has passed a by-law appropriating $2,000 for electric light purposes.

Penn Yan, N. Y.—An appropriation of $1,500 has been made for lighting the streets by electricity.

Sherman, Tex.—The Sherman Oil and Cotton Company will probably put in a 50-light arc dynamo.

Frankfort, Ind.—The dynamo of the electric light plant was struck by lightning recently, and ruined.

Kenton, O.—The Kenton Gas and Electric Company has increased its capital stock from $50,000 to $200,000.

Oakland, Cal.—The trustees have granted a new franchise to the Oakland Electric Light and Motor Company.

Oxford, Ala.—The town has contracted with the Anniston Gas and Light Company, of Anniston, to furnish electric lights.

The Paducah (Ky.) Gas Light Company have purchased a 50-light 2,000- c. p. arc dynamo of the Thomson-Houston make.

The Louisville, Ky., Hotel started their arc and incandescent dynamos last week, and are much pleased with their new light.

Eminence, Ky.—A bill to incorporate the Eminence Electric Light, Water and Ice Company has been introduced in the legislature.

Grafton, W. Va.—The Tygart's Valley Artificial Ice Company and the Grafton Electric Light Company will probably be consolidated.

Suit for Infringement.—The Fort Wayne Electric Light Company is suing the Goshen, Ind., Company for infringement of patent.

Ronceverte, W. Va.—The Greenbrier Dressed Beef Company contemplates putting in an incandescent electric light plant. Machinery is wanted.

Fernandina, Fla.—The Loomis Manufacturing Company will put an electric light plant in its fibre factory, and had not, at latest reports, made the purchase.

Louisville, Ky.—The Phœnix Brewing Company, of this city, have added another Thomson-Houston dynamo of 250-light capacity to their already extensive plant.

Point Pleasant, W. Va.—G. E. Milligan has, it is stated, purchased the electric light plant of the Point Pleasant Electric Light and Power Company, for $1,800.

Riverton, Ala. (P. O. Chickasaw).—It is reported that an electric light plant will be erected. The North Alabama Development Company can give information.

Milwaukee, Wis.—The Board of Public Works estimates the cost of the electric light plant for the city at $575,412.18, making the average cost of each lamp per year about $70.

Richmond, Ky.—Woodbury & Moulton, of Portland, Me., and A. E. Boardman, of Macon, Ga., have purchased the electric light, gas and water works, and will make improvements.

Bamberger, Bloom & Co., of Louisville, Ky., have contracted with the Central Thomson-Houston Company for a plant of 50 arcs and 100 incandescents for their new building on Main street.

The Central Thomson-Houston Company is at present installing an incandescent plant at the Northern Lake Ice and Cold Storage Company's buildings, on Fifteenth and High streets, Louisville, Ky.

Anderson, S. C.—J. E. Roddy, of Rock Hill, and W. C. Witner and others have incorporated the Anderson Electric Light and Power Company, to furnish light and motive power to the city. The capital stock is $10,000.

Cartersville, Ga.—The Georgia and Tennessee Construction Company has been incorporated by H. M. Smith, of Floyd County, and G. H. Aubrey. It is privileged to develop mineral and timber lands, build and operate electric light, gas and water works, factories, etc. The capital stock is $50,000.

Oakland, Cal.—The Oakland Gas Company has been directed to locate electric lights at the following places: Jackson and Lake streets, Madison and Fourteenth streets, East Fourteenth street and Twentieth avenue, East Fourteenth street and Eighteenth avenue, Market and Third streets, Fifth and Grove streets.

The Electric Light in China.—It seems that there is a deal of trouble connected with the introduction of the electric light in China. J. H. Ormerod, an English merchant in Canton, who was recently at the Palmer House, Chicago, thinks that the enterprise will be abandoned. "Several months ago," he explained, "a big syndicate controlling American and English capital started to put in an electric light plant in Canton. The news was heralded over all the world, and many American and Englishmen eagerly took stock in the venture. Not until after the necessary money and the franchises had been obtained did it appear that the scheme would be impracticable. The City of Canton is dead after 7 o'clock in the evening, and only those who have business to attend to are allowed to pass up and down the streets. There is no more need of lighting the streets of Canton at night than there would be of burning the lights here in the afternoon. Then, again, the streets are so narrow that it is with the greatest difficulty that the lines can be put up. But as the work was begun it was deemed best to continue it. A few weeks ago the big boiler came over from San Francisco, and was carted towards the electric light establishment. When about half way to its destination it stuck fast in one of the narrow streets. And there it is now. It can't be moved either way, and a smaller boiler has been sent for.

The United Edison Manufacturing Company.—From information imparted to us by the United Edison Manufacturing Company, it appears that the electric light business in isolated plants and small central stations continues to grow in a very marked and satisfactory manner. The sale of dynamos by the Cash Installations Division of this company during the month of April this year, shows 204 per cent. increase over the corresponding month in 1889, together with a greater percentage of lamp capacity for the dynamos. The dynamos have been installed in all parts of the Union, from the Golden Gate to small villages in Maine; from New Orleans, on the Gulf of Mexico, to the newly settled districts in the far Northwestern territories. The lamp sales have also vastly increased; the sales for the month of April being 116 per cent. more than for the corresponding period last year, showing that the policy of the company in mounting Edison lamps with bases to fit the various sockets that are in use, thus enabling consumers operating plants other than Edison to secure the benefit accruing from the Edison lamp, has been a wise one. For the past eight months the Edison company have been gradually getting their business into such shape that all construction work for the Edison system throughout the United States and Canada is now done by the company themselves under a very comprehensively organized construction force. The company have also established depots of supplies in Chicago, Denver, San Francisco and Canada, in addition to a New York depot, and now carry in each of these localities a complete stock of dynamos, lamps, sockets, switches, catouts, wire of all various makes, and, in fact, all materials used in connection with electric light and power plants. This arrangement is proving extremely satisfactory to the purchasers and owners of Edison plants, as the company can now install a plant upon short notice and can furnish any supplies required immediately from stock located at a short distance from the purchaser. It has generally been accepted by the electric light companies that the summer months show a falling off both in regard to lamp sales and installations. But from the amount of business done and the orders placed with this company, there will be an exception to the rule this summer—at least, so far as the Edison Company are concerned.

APPLICATIONS OF POWER.

Louisville, Ky.—The Central Passenger Railroad Company will, it is reported, extend one of its lines.

Merrill, Wis.—The Westinghouse Electric Company will furnish the electric plant for a street railway at this place.

Laredo, Tex.—It is reported that the Laredo Improvement Company will extend its electric railroad previously mentioned.

South Bend, Ind.—Work on the electric street railway is progressing. The road is expected to be in operation within a month.

Denver, Colo.—President Longstreet says that the new North Side rapid transit plan is settled, and the electric road will be built and in running order by July 1.

Austin, Tex.—The Austin & Travis County Rapid Transit Company is reported to have let the contract for the construction of five miles of electrical railroad. M. M. Shipe is president of the company.

Little Rock, Ark.—The Layman & Rice Railway Motor Company, with H. D. Layman, president, L. R. Stark, vice-president, and C. F. Rice, secretary, has been incorporated to manufacture motors and dynamos.

The Rochester Railway Company, of Rochester, N. Y., have ordered 800 h. p. Heine water tube steel safety boilers for their electric power station. R. M. Huston, 239 Broadway, New York, is agent for these boilers.

Baltimore, Md.—A company has been organized with $50,000 capital stock, by Richard J. Capron, A. H. Rutherfoord, C. O'D. Lee, Lawrence B. McCabe and others, for the purpose of constructing an electrical railroad.

Will Adopt the Storage Battery.—The Rapid Transit Company, of Sioux City, Ia., intends to adopt the storage battery system on its line if it proves satisfactory. The company is now constructing an elevated road.

Cairo, Ill.—The Cairo Electric Railway Company, recently noticed as incorporated, will build about six miles of road in this place. The work will begin within the next 60 days. As yet the company has not decided upon the system it will adopt.

Baltimore, Md.—The Baltimore Union Passenger Railway Company is said to have secured control of the Baltimore & Yorktown Turnpike Railway, and will, it is stated, convert it into an electric railroad. The former company will also, it is reported, extend its lines to connect with the latter road.

Beverly, Mass.—The Naumkeag Street Railway Company has purchased a lot of land on Myrtle street, and will build a power house when the road is equipped with the Thomson-Houston overhead electric system, which will be done at once. It is understood that the treasurer and clerk of the road, J. F. Hickey, will, under the new management, be offered the position of general manager. He has been employed on the road from boyhood.

To Supersede the Dynamo.—A Western man claims to have discovered a chemical process by which electricity can be generated to the extent of 1,600 volts, and the pressure continuously kept up to that point. He claims that electricity can be produced in this way at a nominal cost, and is confident that his process will supersede the dynamo. Street cars and electric lights are operated at a pressure of about 700 volts, and by means of this new discovery electricity can be generated on the cars and the overhead wires dispensed with.

St. Louis, Mo.—A company has been formed here for the purpose of manufacturing and introducing a hydraulic street-car motor. The inventor of the process is A. C. Atwood, of St. Louis, and the new concern is known as the Atwood Electric Company. The pumps with which the hydraulic pressure is exerted are to be operated by electricity, and the hydraulic engines are to be connected directly to the axles of the trucks of the car, thus obviating the heavy gearing that is used in the electric motor. Two tanks, each containing about one-half a barrel of water will be used on each car.

A Large Plant.—Hon. Thomas F. Cloh sy, the Western agent of the Detroit Motor Company, has sold one of the largest electric power plants in the world. The plant, which is to be of 1,000 h. p., is to be installed at Webb City, Mo., and is for use in furnishing power to operate the mines at that place. The price to be paid for motors alone is $98,000, and the Jasper County Electric Power Company, of Webb City, is the purchaser. The stock of the outfit is $150,000, all taken and none for sale. The principal movers in the enterprise are W. P. Munro, Judge Stratton and O. K. Caldwell, of Nevada. Two hundred horse-power will be in operation in 30 days, 500 more in 60 days and the remainder in 90 days. The mines will, on the completion of the plant, be worked night and day, which is an object long desired.

Baltimore, Md.—The Baltimore Traction Company, which is now constructing a cable railroad 7 miles long at a cost of $3,000,000, is about to become the owner of another road on which it contemplates adopting electric traction. The Baltimore, Pimlico and Pikesville Railway, which is seven miles in length, has been purchased by Messrs. T. Edward Hambleton, president, and Howard Munnikhuysen, general counsel of the traction company. It is ascertained from a gentleman in close business relations with these gentlemen that it was purchased for the company of which they are officers. The road is to be made an electric line at once, so far as to the grounds of the Maryland Agricultural Association at Pimlico, four miles from the city. Should this road meet with the success that is expected, it will be equipped with electricity on the full seven miles, and will be eventually extended to Reisterstown, about sixteen miles from Baltimore. An electrical engineer has made a preliminary survey of the route. The traction company applied this week to the city council for the privilege of using electricity as a motive power.

An Important Communication.—The directors of the Westinghouse Electric Company held a meeting on the afternoon of the 4th instant. As a result, the following was addressed to stockholders and others:

PITTSBURG, June 4, 1890.

DEAR SIR: At a meeting of the directors of this company, held May 6, the following action was taken:

Resolved, That a meeting of the stockholders of this company be called, to be held at the office of the company, Westinghouse building, Pittsburg, Pa., on July 8, 1890, at two o'clock, P. M., for the purpose of taking such action as shall be necessary to transfer the business of the Westinghouse Electric Company to the Westinghouse Electric and Manufacturing Company; and to transact such other business as may come before the meeting.

Resolved, That a meeting of the stockholders of this company be called, to be held at the office of the company in the Westinghouse building, Pittsburg, Pa., on July 8, 1890, at 2 o'clock P. M., for the purpose of holding an election for or against an increase of the capital stock of the company; that notice thereof be published by the secretary as required by law; and that the transfer books be closed from July 1 to July 8, 1890, both inclusive.

GEORGE WESTINGHOUSE, JR., President.

With the exception of a few shares, all of the regular stock of the Westinghouse Electric Company has been transferred to the Westinghouse Electric and Manufacturing Company, so that at the time of the meeting a formal action may be assented to, and the business thereafter conducted in the name of the Westinghouse Electric and Manufacturing Company.

The aggregate sales for the year 1889 of the Westinghouse Electric Company and its leased companies, amounted to $4,362,000, and for the first three months of this year in the lighting businss alone the ncrease over the same period of last year was about 80 per cent. Beginning with the month of May, the company began to take orders for the supply of electric railway equipment, and contracts have already been closed during the one month for upward of $200,000 of material, with negotiations well advanced for more than four times that amount; indicating that for the year 1890 the sales of the company will be greatly in excess of last year. In view of the large increase in the company's business, and the need for more capital, the management deem it expedient to defer action with reference to a dividend until after the stockholders' meeting has been held on July 8, 1890. The management believe that they will be able to place the necessary amount of stock, if authorized, to provide the needed capital for the large business the company is now doing.

MISCELLANEOUS NOTES.

Turn About.—Electricity is now utilized in mining coal. And then the coal is utilized in producing electricity.

A Progressive Town.—Fairhaven, located on Bellingham Bay, in the State of Washington, although only a year old, has an electric light plant and an electric railroad. The town polled 1,490 votes at the May election, and is growing rapidly, naturally, without any boom.

"Electrocision" is the word proposed by the Louisville *Courier-Journal* to denote execution by electricity. It would be much better to abandon the new method of killing criminals, and go back to the plain old-fashioned hanging, than to permit that fearful word to go into general use.

The Sacramento, Cal., Electric Construction Company has applied to the Sacramento Trustees for an underground conduit franchise for electric wires. It is proposed to rent out the conduit to various companies, and to furnish the city free use for telephone, fire alarm wires, etc. The city is to receive two per cent. of the net earnings. Work will begin within six months.

Paris Subway Explosions.—Edison when in Paris laid great stress upon the fact that it was dangerous to be sending side by side with gas conduits through subterranean Paris, electrical currents by wires charged with high tension currents, and predicted that explosions would be the result. Many explosions from this cause are now occurring in Paris, and the newspapers in that city are reverting to Edison's warning.

Pullman-Westinghouse.—Sixteen miles from Pittsburgh, Pa., up the Allegheny River, at Parnassus, 850 acres of land have just been secured as a site for extensive electric car works, to be erected jointly by the companies controlled by George W. Pullman and George Westinghouse, Jr. The details of the new enterprise have not been given out, but Mr. Pullman will look after the car works and Mr. Westinghouse will control the electrical appliances.

Mexican Use of the Phonograph.—The Mexican Post Office Department is about to adopt a novel device. A phonograph is to be placed in each principal office in the country for the accommodation of the numerous citizens who cannot read or write. The illiterate Mexican will go to the post office, talk his message into the receiver of the phonograph, and when the cylinder reaches its destination the person addressed will be sent for and the message will be repeated to him from another machine.

New Process for Pulp.—Pulp manufacturers are deeply interested in an electrical method of reducing wood in the manufacture of pulp. By this process it is claimed that the fibre is manufactured so cheaply that the entire pulp business will be revolutionized, and the digesters now in use be driven out. Kelner, of Germany, has been experimenting for several years with electricity in this direction, and has now succeeded in perfecting the process. A patent has been applied for in the United States.

Sinaloa, Mex.—The *Occidental* of Culiacan says that Mr. Flavio Lobato, a well known mining engineer and analytical chemist of that city, has discovered platinum in some ores from the Las Yedras mines in this State. Platinum has more than doubled in price within a year, and if it can be found in any quantity in this state it will certainly have a great influence upon the state's prosperity, as platinum is increasingly used in many industries, and the scientific world is seeking everywhere for additions to the scanty supply afforded by the Russian Urals.

Mr. Edison says that he is tired of having inventors come forward at the eleventh hour to claim devices that he has had in use for years. He particularly does not enjoy the legal attentions of Mr. W. K. Freeman, whose claims, Mr. Edison asserts, have not the slightest foundation in fact. Mr. Edison began to experiment with the incandescent light in November, 1879, he says, and so far from Mr. Freeman having sent him a lamp previous to that time, the first the great inventor heard of it was through a Racine newspaper long after his own experiments.

A Novel Idea.—A new electric device has made its appearance in London. It is an apparatus for measuring the amount of liquor sold at the bar, and for checking and recording the sales and receipts. The amount served depends on the position of a knob, and by means of a series of electric contacts the amount is recorded by a pointer and dial. For each pennyworth of liquor served a distinct contact is made, and the current which then passes is made to excite an electro-magnet and thus turn a ratchet wheel through one notch. In this way the total amount of liquor served is checked.

Cutting Glass by Electricity.—The process of cutting glass tubes by electricity appears to have met with success. The tube is surrounded with a fine wire, whose extremities are put in communication with a source of electricity—it being also necessary, of course, that the wire adhere closely to the glass. When a current is passed through the wire the latter becomes red hot, heating the glass beneath it, and a single drop of water deposited on the heated place will cause a clean breakage at that point. Contrary to what takes place in the usual process of treating this material, it is found that the thicker the sides of the tube are the more successful is the operation likely to be.

Effect of the Electric Light on Plants.—A beautiful illustration of electric light on plants was recently given by Dr. Siemens before the Royal Society of England. He placed a pot of budding tulips in the full glare of the electric light in the meeting room, and in about forty minutes the buds had expanded into full bloom. In giving a statement of some of his experiments Dr. Siemens said that he had planted a number of quick growing seeds in pots, and divided the pots into four groups; one group he had kept entirely in the dark, another he had exposed to the influence of the electric light only, another to the influence of daylight only, and another to electric light and daylight in succession. Death soon resulted to those plants which were kept entirely in the dark; those exposed to the electric light only, and those exposed to the daylight only, throve about equally; and those exposed to both day and electric light throve much better than either.

The Taylor Manufacturing Company, of Chambersburg, Pa., among their recent sales report the following for Beck automatic engines, both horizontal and vertical styles: One 12 and one 2 by 15 engine to the Reeds Lake Electric Railway Company, of Grand Rapids, Mich.; one 7 and one 2 by 8 engine to Norfolk & Western Railroad, Roanoke, Va.; one 16 by 18 engine to the Edison Electric Illuminating Company, of Tiffin, Ohio; one 12 and one 2 by 15 engine to Virginia Electric Light and Power Company, Richmond, Va.; one 8 and one 2 by 10 and 5 by 6 vertical automatic engine on combination base for dynamo to J. M. Badger, St. Paul, Minn.; two 10 and one 2 by 12 engines, with boilers, etc., to the Cleizens' Electric Light and Power Company, of Lansdowne, Pa.; one 11 by 12 engine with complete steam plant for Ball Electric Plant at Cedartown, Ga.; and one 15 by 18 engine with boilers, etc., for Scottdale, Pa., Electric Light Company.

Barber Starkey's Accumulator Cut-out is now on exhibition at the Edinburg Exposition by Messrs. Woodhouse & Rawson's United, Limited, of London, England. This instrument is designed for automatically closing the charging circuit of accumulators as soon as the dynamo shall have reached a predetermined E. M. F. and breaking the same circuit when the E. M. F. drops below a predetermined point. Its action is founded upon the rotation of the armature of an electro-motor acting against the force of an adjustable weight. It is so designed that the action of making and breaking circuit is quick and decided. It absorbs a quite negligible amount of power, and is entirely independent of the amount of charging current. One feature of the instrument is the method by which the position of the armature when at rest with respect to lines of force, can be altered, thereby enabling the points of cut-out to be adjusted to any desirable E. M. F.

BUSINESS NOTICES.

The Peckham Street Car Wheel and Axle Company, manufacturers of Peckham's motor wheels and axles, whose trucks are in use on so many electric railroads, has moved to more convenient offices at 45 Broadway.

The Magnetic Iron Ore Company, of Carthage, N. Y, have ordered 300 h. p. Heine water tube safety boilers. They will be built by Van Sile, McCormack & Co., of Albany, N. Y. R. M. Huston, 239 Broadway, New York, is agent for these boilers.

Mr. Emil Gabel, manager of the New York house of the Charles Munson Belting Company, of Chicago, has just received an order for 119 ft. of 48-in., three-ply belting from the Brush Electric Light Company, of Philadelphia. The Munson belting is adding greatly to its well deserved popularity.

The Easton Electric Company, 45 Broadway, New York, are having installed in Wechsler & Abrahams' palatial dry goods store in Brooklyn, over 100 arc lamps with the accompanying dynamos. The Tucker Electric Construction Company, 22 and 24 Whitehall street, are doing the construction work.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 115 South Warren street.

The Eclipse Wind Engine Company, Beloit, Wis., has furnished the outfit for the extensive additions to the Louisiana Electric Light and Power Company of New Orleans. The order included all the machinery requisite for the transmission of 3,000 h. p. The works of this company are kept running night and day to keep abreast of the demand for machinery in their line.

Warning to Investors.—Suit against the United States Aluminum Metal Company, of New York, operating the so-called Herault process of electric smelting, has been begun by the Cowles Electric Smelting & Aluminum Company, of Cleveland, O. The alleged process of Herault is a gross infringement of the Cowles patents, and investors are hereby warned that we shall maintain these claims to the full extent of the law.

EUGENE H. COWLES, President.

The National Conduit Manufacturing Company, *Times* Building, New York, are about to begin work on 90,000 feet of their cement-lined pipe for the New England Telephone Company. This order is a very gratifying one, as they last year laid 40,000 feet for the same company, and this second and much larger order, following the initial order, shows that the conduit supplied is in every respect satisfactory. The National Company are also laying a system of 220 ducts in one trench. This is said to be the largest number of ducts ever laid in one trench.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JUNE 3, 1890.

429,107. Electro-Magnetic Locomotive; Richard N. Allen, of Cleveland, Ohio. Application filed Jan. 24, 1890. The combination, with a truck or frame, of the driving wheels having bearings therein, the uprights or frame rigidly secured to the truck, the motor mounted on the frame, a shaft mounted on the truck, intermediate reducing gears between the motor and said shaft, and connections between the shaft and the driving wheels.

429,109. Apparatus for Rectifying Electric Currents; Frank Anderson, of Peekskill, N. Y. Application filed Nov. 20, 1889. An armature for an alternate current dynamo having two sets of bobbins, one of which is fixed to the shaft and the other adjustable.

429,113. Trolley Carrier; Benjamin F. Brown, of Boston, Mass. Application filed March 14, 1890. The supporting arm, combined with the trolley carrier connected with it, and having an independent rocking movement on its own axis and the trolley carried by it.

429,115. Printing Telegraph; John Burry, of Boston, Mass., Assignor of one-half to Aloys Wirsching, of New York, N. Y. Application filed July 25, 1889. A rotating selector wheel having varying lengths of teeth, pegs arranged at various points around the circumference thereof and at different distances from the center of said selector for positioning the same, and magnets controlling said pegs.

429,129. Magneto Telephone; Noel B. Ginochio, of New York, N. Y., Assignor of one-half to Elias M. Greene, of same place. Application filed August 6, 1889. In a magneto telephone, the combination, with the permanent magnets, of a plate connecting all the plates of one name, a flange on the plate, a cord of fine wires supported in the flange, a ring of magnetic material connecting the poles of the opposite name, and a diaphragm supported on the ring.

429,133. Fuse Box; Carl E. Kammeyer, of Eau Claire, Wis. Application filed April 1, 1890. A fuse box consisting of a series of vertically grooved terminals with means for connecting one end of a conductor to each and insulated from each other, with a lid provided with a series of tongues to engage such grooves, said tongues connected by fuse pieces to suitably complete the circuits when the lid is on.

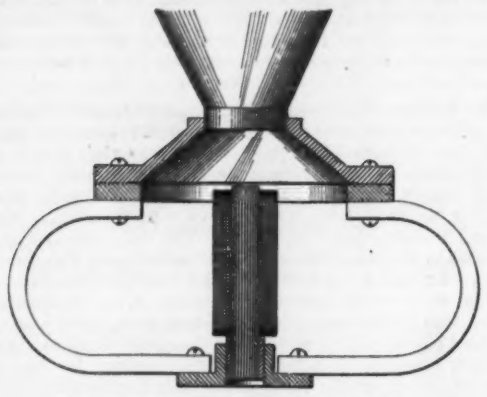
429,199. Electric Railway System; William D. Macques tion, of New York, N. Y. Application filed Sept. 28, 1889. In an electric railway system the combination, with a main or working wire or conductor composed of insulated sections, of a side main composed of independent sections, a working wire feeder to con-

nect the side main sections to the main wire sections, a side main feeder and a pressure wire.

429,233. Multiple Telegraphy; Edward N. Dickerson, Jr. of New York, N. Y., Assignor to the Western Union Telegraph Co., of same place. Application filed May 22, 1877. The combination, with the main line circuit, of three continuity preserving keys situated at the same station. two of which send currents of different intensities in the same direction and the other of which reverses the entire current.

429,251. Cover for Electric Subways; John Stafford, of New York, N. Y. Application filed March 19, 1890. The invention consists in the combination with the inclosing wall of a manhole or testing chamber, of an outer concentric wall or casing, placed so as to leave an open interval between the two, and carried up higher than the inner wall, and of a cover made to fit closely upon the top of the inner wall with a tight joint, and to project beyond the same into contact with the inner periphery of the outer wall, so as to be encircled and protected thereby.

429,255. Machine for Covering Cable; James D. Bishop, of New York, N. Y., Assigner to James Bassnett Atherton, of same place. Application filed March 6, 1890. The combination, with a lead cylinder, of a block having a chamber forming an extension



No. 429,129.—Magneto Telephone.

of the lead cylinder, an aperture for a hollow core-bar transverse to the axis of the cylinder, and an opening on the opposite side, also extending into the cylinder, and a removable apertured partition, in which the inner end of the core bar is mounted, a recessed plug and a die mounted therein concentrically with the hollow core-bar.

(1) 429,272. (2) 429,274. Electrode for Secondary Batteries; Carl Hering, of Philadelphia, Pa. Application filed (1) Feb. 11, 1889. (2) April 18, 1890. The process of making and hardening a plate adapted to become a secondary battery electrode, consisting in mixing lead oxide with a solution of a salt of lead to a paste pressing it in a mold, drying it and immersing it in sulphuric acid.

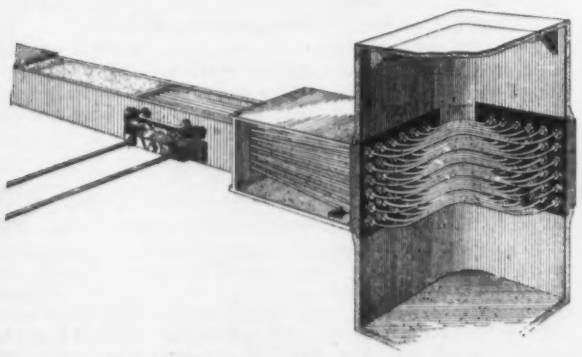
429,273. Secondary Battery; Carl Hering, of Philadelphia, Pa. Application filed May 24, 1889. The combination, in a secondary battery cell, of two or more blocks of lead peroxide in positions parallel to each other, with removable conducting plates and two or more blocks of spongy lead in positions parallel to each other, with conducting plates and removable clamps adapted to hold the blocks severally in contact with their conducting plates, and upon removal to allow the plates and blocks to be moved.

429,277. Electric Tramway and Car; Alexander Login Lineff, of Chiswick, County of Middlesex, England. Application filed March 6, 1890. The invention consists in the combination of two rails having rabbitted heads to form both the wheel groove and the channel slot, two sets of rubbers, one set in connection with a main conductor and the other with the rails, or a return wire or earth, a double traveling conductor carried by arms connected with the car and working in the channel slot, a six-wheeled car having four wheels mounted on a bogie, to which beams carrying the collector arms are pivoted, and the other two wheels on a common axle, one being loose, a permanent way in which the points are provided with underlying pivoted lozenge-shaped supporting plates, and means for operating the plates and points by hand.

429,286. Apparatus for Detecting Leaks in Pipes; William Woodward Rosenfield, of Brooklyn, Assignor to Anthony Rosenfield, of New York, N. Y. Application filed Sept. 4, 1886. The combination with a water pipe, of a translating device located in an electrical circuit, reversely arranged primary and secondary controllers located respectively distant from, and adjacent to the exit of such pipe and operated on the flow of water near them, and connections between said controllers and the circuit, whereby the operation of said primary controller operates the translating device and the operation of the secondary controller neutralizes the effect of the primary controller and prevents the operation of the translating device.

429,304. Electric Conductor; Henry B. Cobb, of Wilmington, Del. Assignor to the Cobb Vulcanite Wire Company, of Delaware. Application filed Nov, 8, 1889. An electric conductor, comprising in combination, a wire inclosed in an insulating substance, the whole being enclosed in a tube of hard insulating substance, each as vulcanized rubber, and soft insulating material, such as wax, interposes between the other insulations.

429,305. Electric Conductor; Henry B. Cobb, of Wilmington, Del., Assignor to the Cobb Vulcanite Wire Company, of Delaware. Application filed Nov. 8, 1889. A metal-coated insulated



No. 429,307.—Underground Conduit.

conductor, comprising a wire, inclosed in a hard rubber tube, the latter inclosed in a molded covering of metal, and an intervening soit insulating material, presenting a continuous filling between the tube and covering.

429,306 Joint for Electric Conductors; Henry B. Cobb, of Wilmington, Del., Assignor to the Cobb Vulcanite Wire Co., of Delaware. Application filed Nov. 9, 1889. The method of joining the separate ends of a metal covered electric conductors, which consists in bringing together and securing the ends of the wire, inclosing the said connected ends in insulating material, and inclosing the joint thus partly formed in metal.

429,307. Underground Conduit for Electric Wires; Henry B. Cobb, of Wilmington, Del., Assignor to the Cobb Vulcanite Wire Co., of Delaware. Application filed Nov. 8, 1889. In an electric underground system, the combination of a conduit box extending between manholes and having any desired number of flexible tubes of insulating material supported within it and extending from manhole to manhole.

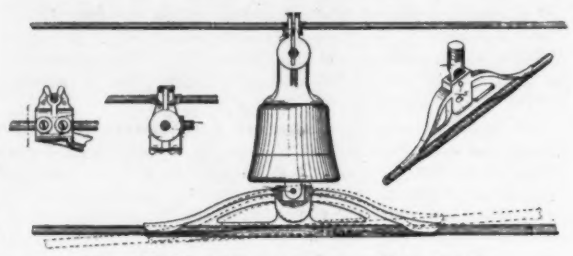
429,315. Insulator for Electric Railways; William D. MacQuesten, of New York, N. Y., Assignor to Charles L. Edgar, Trustee, of Boston, Mass. Application filed July 15, 1889. The invention consists in the combination with a span wire or rod and side supports therefor, of a trolley wire and a hanger or suspension secured to the said span wire and consisting of a bracket or spreader provided with upright portions through which the span-wire is extended and a pivoted shoe secured to the bracket.

(1) 429,316. Tension Bracket for Trolley Wires; William D. MacQuesten, of New York, N. Y., Assignor to Charles L. Edgar, Trustee, of Boston, Mass. **(2) 429,314. Continuously Operated Electric Motor.** Applications filed (1) Oct. 9, 1889, (2) July 3, 1889. (1) The invention consists, in the combination, with a support for the trolley wire, of a rod connected to the said support and provided with a cap of insulating material and a swivel fitted upon the cap and adapted to be connected to a post or upright. (2) The invention consists in the combination with an electric motor, of a loose gear connected to the armature of the said motor and provided with a series of armatures, and a magnetic clutch mechanism consisting of a series of magnets co-operating with the armatures to hold the gear fast or stationary when desired.

429,318. Electric Fire Alarm and Extinguishing Apparatus; Charles E. Ongley, of Yonkers, Assignor to himself and Thomas W. Robertson, of New York, N. Y. Application filed Dec. 27, 1889. The combination, with water pipes provided with outlets, valves in said pipes, an electro magnet for opening and an electro magnet for closing each valve, circuits including the magnets and extending to the office or similar point, and switches for the circuits, also at the office, of automatic fire alarm signal transmitters distributed about the building and a signal receiver connected therewith.

429,327. Electric Railway Motor; Frank J. Sprague, of New York, N. Y. Assignor to the Sprague Electric Railway and Motor Company, of same place. Application filed Oct. 31, 1889. The invention consists in making use of the vertically movable axle boxes upon which the truck frame or car body is supported by springs or flexible supports as a support also for the the motor or motors, being also preferably through springs or flexible supports.

429,334. Process of Maintaining a Uniform Current in Electric Circuits; Julien M. Bradford, of Portland, Me., Application filed September 22, 1888. The method of rapidly compensating variations of current in a generator circuit, which consists in causing two or more regulating devices or other com-



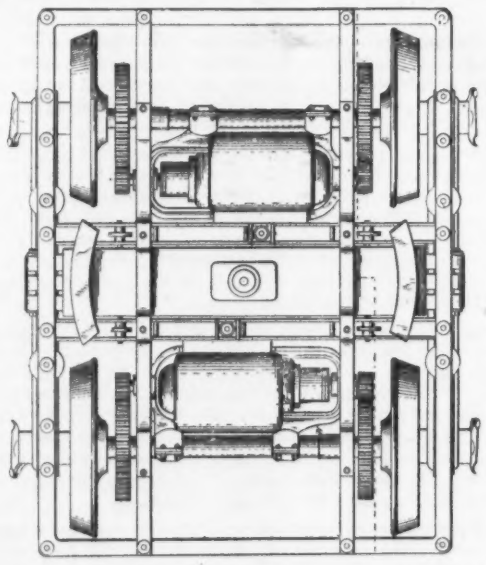
No. 429,315.—Insulator for Railways.

pensating agents to act accumulatively, each with a progressively increasing effect the instant the current varies, either by increase or decrease.

429,377. Telegraphy; Shirley Middleton English, of New Orleans, La., Assignor of one-half to Alexander F. Wark, of same place. Application filed Feb. 4, 1890. In a telegraph system, the combination, with a vertically swinging lever and a second lever actuated therefrom and in electrical connection with the main line, of two pivoted arms extending at opposite sides of said second lever, in the path thereof, and connected with opposite poles of a battery and a spring for causing the said second lever to make firm contact with the two arms.

429,396. Electrical Clock Winding Mechanism; Charles Adelbert Ward, of Waterbury, Conn. Application filed Aug. 26, 1889. In an electrical clock winding device, the combination with a time train, of a gear on the spring shaft, a winding gear meshing therewith, a motor connected and adapted to operate the winding gear, the pivoted circuit closing rod and terminals adapted to be closed thereby, and a pin on the gear of the spring shaft adapted to engage and to move a circuit closing rod both into and out of contact with the terminals.

429,413. Trolley for Electric Railways; Warren S. Blauvelt, of Asbury Park, N. J., Assignor to the Sea Shore Electric Railway Company, of same place. Application filed Oct. 9, 1889. The two pairs of trolley wheels, the links and the axes on which the wheel revolves, in combination with the arms carrying such axes, the side pieces on which the arms are pivoted and the



No, 429,327.—Electric Railway Motor.

hinges connecting the side pieces together to form the body of the trolley.

429,447. Medical Battery; Franklin P. Hoeneman and William A. Hoeneman, of New York, N. Y. Application filed Nov. 18, 1889. The combination of a battery, a case therefor having a hinged cover, and connections between one of the electrodes and the cover, whereby the lowering of the cover removes the electrode from the acid and the raising of the cover restores it to the acid.

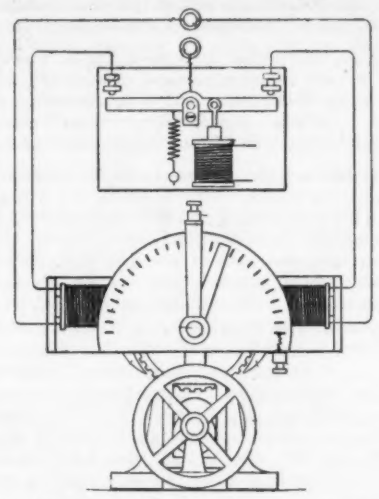
429,478. Interlocking Electric Railway System; Joseph Ramsey, Jr., and Fredric C. Weir, of Cincinnatti, O. Application filed March 21, 1889. The combination, with the railway switches and signals, and one or more switch rail electrical motor circuits and electrical signal motor circuits, of the electric generator, an electric switch rail motor, and an electric signal motor actuated by the generator, circuit breaking devices, and mechanism for operating the railway switches and signals from said motors through the circuit breaking devices in such a manner as to actuate the signal only after the operation of the switch rail motor of the coacting circuit.

429,483. Electric Railway Signaling Apparatus; Charles H. Rudd, of Evanston, Ill., Assignor of one-half to James W. White, James Clarence White and Henry M. Lewis, trustees, of Philadelphia, Pa. Application filed March 24, 1890. The combination of a continuous rail conductor, insulated cross connected rails constituting return conductors, a motor and devices through which the current passes from the continuous to the return conductors through the motor.

429,490. Field Magnet for Dynamos; Edmund Wagemann, of Little Rock, Ark., Assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis and John H. Jones, all of the same place. Application filed Sept. 16, 1889. In a field magnet for a dynamo or motor, the combination of a magnet coil wound upon a spool which is hollow, a bundle of iron wires filling the hollow part of the spool except for the usual interstices left between the wires, iron filling between the wires and the pole pieces for the machine and lapping over and pressing upon the ends of the spools and covering the said wires and fillings.

429,500. Electric Heating Apparatus; Charles E. Carpenter, of Minneapolis, Minn, Assignor by direct and mesne assignments to the Carpenter-Nevens Electric Co., of same place. Application filed Dec. 17, 1889. In an electro-heating apparatus, the conbination, with an internal layer or card of incombustible electrical insulating material and resistances lying on one or both faces thereof, of a layer of electrical insulating material covering each of the resistances and exterior heating surface plates.

(1) 429,534; (2) 429,535. Manufacture of Carbon Filments; Achilles de Khotinsky, of Gelnhausen, Prussia, Ger. Application filed February 3, 1890. The process of manufacturing carbon conductors for incandescent lamps, which consists in treating natural purified cellulose with sulphuric acid of about 50 degrees Baume, washing the product first with water and subse-



No. 429,333.—Uniform Current Device.

quently with alcohol, forming strips or threads from the colloid cellulose thus produced and carbonizing them.

429,559. Electric Heating Apparatus; Charles E. Carpenter, of Minneapolis, Minn., Assignor of direct and mesne assignments to the Carpenter-Nevins Electro-Heating Company, of same place. Application filed Dec. 17, 1889. In an electro-heating apparatus the combination, with the body, the heated surface thereof, an electrical resistance, a layer of electrical insulating material, between said resistance and plate, and a layer of electrical insulating non-heat conducting material between the resistance and the body, of a compressor plate lying parallel with the surface plate for forcing the resistance and layers toward the surface plate.

429,561. Electric Soldering Iron; Charles E. Carpenter, of Minneapolis, Minn., Assignor, by direct and mesne assignments to the Carpenter-Nevens Electro-Heating Company, of same place. Application filed March 18, 1890. In an electric soldering iron, the combination, with the core or body, the resistance disposed upon the body, and an electric insulation interposed between the resistance and the body.

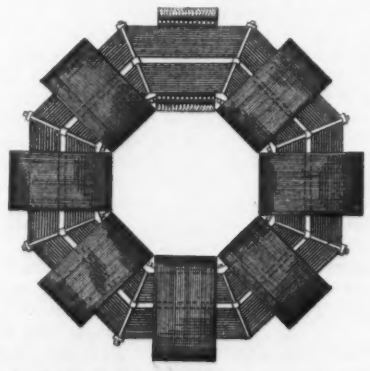
429,562. Method of Electric Heating; Charles E. Carpenter, of Minneapolis, Minn., Assignor by direct and mesne assignments to the Carpenter-Nevens Electric Heating Company, of same place. Application filed March 18, 1890. The method of intensifying the heating effects produced by passing a current of electricity through a resistance, the same consisting in subjecting an insulated resistance to a pressure binding the same against the plate or body to be heated.

429,573. Electric Arc Lamp; Chauncy F. Keller, of Lima, O., Assignor of one-half to Frank Buchanan, of same place. Application filed Jan. 11, 1890. In an electric lamp, the combination, with electro-magnets, movable core, and a pivoted frame having loose connections with the core, of a spring bearing on each side of the pivoted frame, and thumb nuts or equivalent devices for regulating the tension of the springs.

429,576. Printing Telegraph; Andrew T. McCoy, of Boston, Mass., Assignor to John Anderson, of New York, N. Y. Application filed Oct. 17, 1887. In a printing telegraph, the combination of one or more revoluble plates or pin holders, pins movable in the plates or pin holders, a circuit closer to co-operate with either of the pins, a keyboard, and levers or like connections to move the pins in the plates or pin holders by means of the keys of the keyboard.

429,577. Printing Telegraph; Andrew T. McCoy, of Boston, Mass., Assignor to John Anderson, of New York, N. Y. Application filed Oct. 27, 1887. The invention relates to a printing machine or "ticker" for a printing telegraph; and it consists of a type wheel revoluble in either direction, combined with certain devices for effecting the required movements of the type wheel.

429,582. Electric Railway Signal; Homer A. Parrish, of Jackson, Assignor to the Parrish Electric Track Signal Company, of Detroit, Mich. Application filed Feb. 19, 1890. In an electric signal, the track signaling instrument having two or more dissimilarly constructed circuit controllers, one of which comprises the rail of the track and the contact strip, and independent cir-



No. 429,583.—Electrical Converter.

cuits leading from the controllers to an electric signal or signals common to all of said circuits.

429,583. Electrical Converter; Gustav Pfannkusche, of Cleveland, O. Application filed Sept. 28, 1889. In a converter, the combination, with an annular core, of primary and secondary coils wound transversely around the core, and corner pads inserted between the coils and between the coils and core, thereby forming ventilating spaces between the core and coils and between the coils.

429,584. Fuse Box; Nathan S. Possons, of Cleveland, O., Assignor to the Brush Electric Co., of same place. Application filed May 22, 1889. In an electric cut out of fuse box, the combination with a box provided with a removable cover and a contact in the cover, of a contact in the box having a clamping jaw and a flange formed integral therewith, and a clamping screw inserted through the flange from the inside of the box and adapted by being forced outwardly to clamp the conductor between the clamping jaw and end of the screw.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give date and number, and address **The W. J. Johnston Co. Ltd., Times Building, N. Y.**